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QRPp



NORCAL EXCLUSIVE:

Gringo's Busted at the Border



QRP TO THE FIELD from the NM/TX/MEXICO Border

Journal of the Northern California QRP Club

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From the Editor

by Doug Hendricks, KI6DS

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This is going to be short and sweet this time. Congratulations to Jim Cates, Chuck Adams and Wayne Burdick, three prominent NorCal members who were inducted into the QRP Hall of Fame along with Gus Taylor, of the G-QRP Club at Dayton this year. I will have the full story

next issue.

Be sure to read the NorCal 20 kit announcement in this issue. Full details on the next kit. And there are several 2N2222 Design Contest articles in this issue. There will be 3 more to come. Finally, the Pacificon announcement is on page 3. Hope to see you there. Remember, NO EXTRA CHARGE for the QRP events.

Pacificon 98

QRP Forum Announcement

NorCal QRP Club is pleased to announce that they are again sponsoring the QRP Forums at Pacificon 98. We have lined up a world class set of speakers and are very proud to announce the following schedule:

8:00 Bill Jones, KD7S, "Building Cheap Cabinets for your QRP Projects"

9:00 Joe Gervais, AB7TT, "How to operate QRP contests in the Field and have fun"

10:00 Paul Harden, NASN, "Solar Activity and how it affects QRP"

11:00 Dave Fifield, AD6AY, "Designing the NorCal 20"

12:00 - 1:00 Lunch on your own.

1:00 Ade Weiss, W0RSP, "Propagation Charts and how to use them"

2:00 George Dobbs, G3RJV, "The G3RJV 6 Pack"

3:00 Roy Lewallen, W7EL, "QRP Field Day Operation"

4:00 Roy Lewallen, W7EL, "Antennas for Field Day"

Then we will meet again at 7:00 for the QRP Open House. There we will have the judging for the annual NorCal Building Contest. This year there are 3 divisions:

NorCal Transistor Transceiver Contest

1. Design a QRP Transceiver for any band.

2. Use as many transistors as you wish.

3. Use any kind of transistor, i.e. NPN, PNP, FET, MosFET, etc.

4. Passive mixers may be used. TUF-1's, SBL-1's etc. are ok, IC's such as NE602's, the Plessey series and the 1496's are not

5. No IC's may be used other than 3 pin voltage regulators.

6. Design must be accompanied by a legible schematic on 8.5 x 11 paper, use as many pages as needed.

7. A brief description of the circuit and the design, this must be typed and may be up

to 5 pages.

8. Need not be present to enter, but entrant is responsible for getting entry to and from Pacificon. Jim Cates and I will not be able to handle any entries.

9. Winners of Dayton 2N2222 Contest not eligible.

10. Entrants to 2N2222 contest not eligible for entry in K5FO unlimited class.

11. Judging to take place at the NorCal QRP Open House at Pacificon, Saturday, Oct. 17th at 8 PM.

12. Entry in the contest will give QRPP first rights at publication of the article on the project.

13. Diodes, such as LED's, pin diodes, silicone, germanium, shottky, etc. are acceptable.

The purpose of this contest is to avoid using IC's so that a better understanding of the circuit will be apparent.

K5FO Unlimited Contest

Open to any QRP Project built since Pacificon 97.

NorCal K8FF Paddles

Open to all NorCal K8FF Paddles.

Note: Prize winning entries at Dayton are not eligible for this contest. Also, Participants do not have to be present to enter, but must make their own arrangements to get entries to and from contest.

Pacificon 98 will be held on Oct. 16, 17, and 18th with the QRP Forums held Oct. 17th. The convention is at the Sheraton Hotel in Concord, CA. Please contact the hotel directly for special rates. There will be a charge by Pacificon to get into the convention. But there is NO additional charge to attend the QRP Forums. NorCal QRP Club is paying the airfare and hotel accommodations for the speakers. This is our way of saying thank you to our members.

The NorCal 20 Transceiver Project Announcement

by Doug Hendricks, KI6DS

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The NorCal QRP Club is very proud to announce their latest project, the NorCal 20, a 20 Meter Transceiver with the following features:

- *Superhet Receiver

- *5 Pole Crystal Filter

- *AGC

- *TFM-2 Mini-Circuit Mixer (similar to SBL-1) for the front end, NOT another NE602 front end.

- *Variable power output 0 - 5 Watts

- *Varicap tuned VFO, standard 10K pot shipped with kit, but board layed out for 10 turn pot to drop in. User bandwidth selectable from 10kHz to 200kHz on any portion of the 20 Meter band.

- *RIT/XIT

- *Self-contained Custom Keyer chip designed exclusively for NorCal by Brad Mitchell and Gary Diana of Embedded Research.

- *LM380N 2 Watt Audio Chip. Easily drives a speaker.

- *Frequency Readout via Audio Frequency Annunciator. A PIC chip is used as a frequency counter with audio output. In automatic mode, a beep is generated ever kHz. When you stop tuning, the last two digits of your frequency is announced in Morse. You may also push a button to announce your frequency. In manual mode, the frequency only is announced by pushing a button. User selectable modes. Custom designed by Mike Gipe of Blue Sky Engineering.

- *All parts, controls, connectors, knobs supplied.

- *No wiring. All parts chassis mounted.

- *Double sided, plated through, solder masked, silk screened board, commercial quality.

- *Custom aluminum case, using the St. Louis Tuner/SST style case. 1.5" high x 4.5" x 4.5"

- *Comprehensive Manual, written in the build a section, test a section style.

- *No exotic test equipment needed to build

- *Over 225 board mounted parts. No surface mounted parts

- *Full QSK, No Relays, No thump!

- *9 MHz IF, 5 MHz VFO

This is a full fledged NorCal Project, and is not one of our "Design Contest Rigs". This design was commissioned by Jim Cates and myself to fill a specific need and some backround is necessary.

Some of you may not know it, but in 1996, NorCal and the G-QRP club did a project together where we kitted 20.Epi-phyte 2 transceivers to give away to third world country hams who cannot afford ham equipment. These were mostly students who were licensed at school and operated the school station, but when they graduated, they had no way of getting on the air. NorCal supplied the boards, all board mounted parts except for the filter and Toko coils, and the G-Club put the kits together, provided the coils and filters and Derry Spittle wrote the manual. The rigs were sent to several countries and were highly successful and very well received. This project cost over \$2000 which came from excess funds in NorCal and G-QRP Club.

Last summer I visited George Dobbs, G3RJV, who is the leader of the G-QRP Club and one of the most famous hams in the world. During my visit, the subject of the Epiphyte kits came up, and George said to me that we must find a way to get many, many more kits to third world countries.

The response to the article about the Epi-phyté kits in Radcom had generated a deluge of requests for kits.

I thought about our conversation for several months and then one day I was looking through some old QST's doing research for the "Back to the Future" Tuna Tin 2 series and came across the articles on the ARRL Project Goodwill. This was a project that sent 500 stations to 3rd world countries in 1979. The project included a separate transmitter and direct conversion receiver, and several stations were put on the air, but there were some problems. Dave Sumner, K1ZZ, of the ARRL told me that the band, 20 meters, was perfect, but that the builders in the third world countries had trouble with the kits because of their being separates, and the DC receivers were not that hot.

When I ran the NorCal 20 project by him, he was very enthusiastic and has encouraged us to do the project as we will learn and profit from the ARRL's mistakes. I am not being critical of the ARRL here, just pointing out that they were the first to try this idea, and they learned a lot from it and have very graciously shared that information with us so we don't have to reinvent the wheel.

Jim and I talked over the idea and decided that we would go for it, but we had to come up with a way to finance it. I told Jim that I thought the best way was to sell kits at a higher price than normal, and to take the excess and use it to provide kits for the 3rd world countries. Jim agreed and we started.

The first objective was to find a designer. There are many competent designers in NorCal, but this one had to be special. The main emphasis on the design of this transceiver was that it was going to be used in 3rd world countries, and the receiver had to be solid, and we could not use a NE602 front end. One of the de-

signers that I have worked with is Dave Fifield, who had mentioned to me while working on the 38 Special that he wanted to design a transceiver with a "real front end" some day.

Dave was perfect. He knew the conditions in Europe, as he is from England originally and has lived and worked in the Middle East. RF conditions in those countries are far different than here in the US. I called him, explained what Jim and I wanted to do, and asked him if he was interested in designing the NorCal 20. He readily accepted, and we were on our way.

We put together a team to work on the NorCal 20. Dave is the chief designer, but is getting consulting help from Dave Meacham, W6EMD, who is an expert on Filters and RF, Mike Gipe, K1MG, who is helping with the integration of the frequency counter and testing the overall design. Brad Mitchell and Gary Diana have designed a custom keyer chip for the rig. Bill Jones and Doug Hauff have spent many hours working on the design of the case. They came up with some exotic ideas, but they just wouldn't work with our constraints of having to ship to 3rd world countries. Finally, we settled on the St. Louis Tuner/SST type case. Paul Harden will do the illustrations in the manual and check the prototypes for spectral purity and evaluate the design. Richard Fisher will proof the manual. Jerry Parker is in charge of Web Page publicity. George Dobbs and the G-QRP Club will handle distribution of the rigs to the 3rd world countries. Jim Cates will handle the orders and shipping. Dave Gauding and Jim Smith of the St. Louis QRP Club have helped with parts procurement. And I am the project manager.

We have built 3 prototypes and had them all on the air. This is round one. From this round we found a list of things as long as your arm that need to be fixed, and they

will be in round 2. After that we will evaluate the design and make a decision as to the need for another round of testing. But we will not go to production until this rig is ready and right.

It will be thoroughly tested by the best that we have, and we will make every effort to assure you that the NorCal 20 is the best kit that we can make.

The kit will sell for \$95, and we will only sell 500 kits, and with the proceeds from the 500 kits, we will kit another 500 to send to the G-QRP Club for distribution to hams in 3rd world countries at no cost to them. The kits will be hand carried to the hams in the 3rd world countries to assure that they get to the proper destination.

Orders for the kits will be accepted starting Aug. 1st. Here is the ordering information. Send a check or money order in US funds for \$95 plus \$5 shipping in the US, \$10 Canada, and \$15 DX for each kit ordered. Send your orders to:

Jim Cates
3241 Eastwood Rd.
Sacramento, CA 95821
USA

Make checks or money orders out to Jim Cates, not NorCal. US funds only. European members may order from Steve Farthing. The cost is 65 pounds Sterling. Steve's address is:

Steve Farthing
38 Duxford Close
Melksham, Wiltshire
SN12 6XN
England

Steve will relay the information to Jim and the kits will be shipped from the US.

Some of you may wonder why we are charging \$95 for the kit when we are obviously able to kit 2 radios for that price. Why not sell one radio for \$50? Well, NorCal has caused a problem with the QRP suppliers. When we do a kit and we

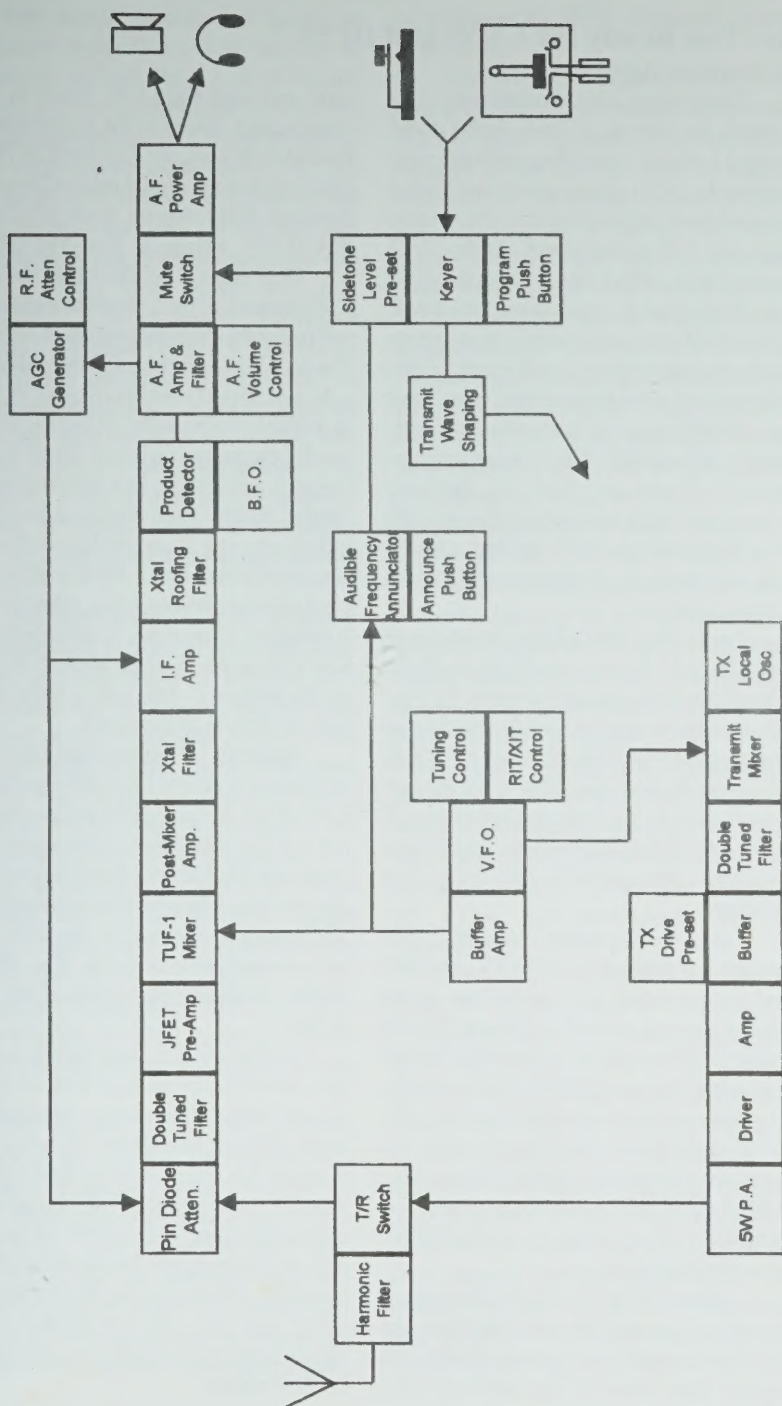
get volunteer labor to do it, we can sell kits much cheaper than the commercial guys. We want them to stay in business, because the hobby needs them and they are very valuable.

One option would be for us to just add the same markup as the commercial vendors. That would solve the problem, but create another. What does NorCal do with the money? No, we chose to use the excess to do a good deed, a gesture of friendship. We also feel that the NorCal 20 is still a huge bargain. Try to find a rig with all of its features for the same price. You can't do it. Realize also that 5 years ago the club sold the NorCal 40 for \$95. But it was not a 5 Watt rig, it didn't have near the receiver that the NC20 does, it didn't have a keyer, it didn't have a frequency counter, and the case wasn't nearly as solid. Plus the board was not of commercial quality. How can we do it now? Because we have learned so much through the years. We have found contacts, new ways of doing things, better parts sources, and we have just improved on things. It is called progress.

Let me end by saying that no one is required to buy the kit. We put it on 20 meters because that is the best band for our requirements. It is open somewhere, every day. I thank also all of the contributors to the design. Their work is immense and greatly appreciated.

The target date for shipping the kits is late October, perhaps by Pacificon. All of this hinges of course on parts availability and no major problems in the process, which we don't foresee at this time. Remember, only one run of 500 kits. If you want one, order quickly, because we will not be doing another run. Jim will start taking orders Aug. 1st. I am looking to seeing the final product and then using it to work a DX station and hearing him say, rig here is NC20!! What a thrill that will be.

NorCal 20 Block Diagram - Designed by Dave Fifield, AD6AY



Are You Ready for CCW and BPSK?

de Vic Black, AB6SO

There's been a lot of recent press concerning the rebirth of Ham Radio about every 11 years, coinciding with the sunspot cycle. All's gloom and doom during sunspot lows and nothing but DX, happiness and TVI at the peaks. At the 1957 sunspot high, QRM was so great that SSB was developed to save spectrum space. Using SSB was considered almost unsociable because of the racket it created compared to AM, even though there were fewer squeals and squawks from adjacent interfering carriers with SSB. The ensuing upheaval meant we had to upgrade equipment which had worked fine up until then, but in the long run it proved to be the best solution to the challenges of HF voice communications.

During the 1960's FM repeaters were introduced. I was working in Palo Alto at Hewlett-Packard when a PA system announcement was made that Varian had installed an FM repeater on Black Mountain for ham use. This was a revolutionary idea at the time. We now know it as the 147.315 repeater whose trusteeship recently changed to the HP club WW6HP.

Later developments included development and general use of SSTV, satellites and packet radio. During the last cycle, packet gave up ground to Amtor, Pactor, Pactor II, Clover and the Automatic Packet Reporting System (APRS). Predictions for the future are tough since we have no control over the future. Anyhow, I'll stick my neck out and predict that this next cycle will finally see wider acceptance of coherent CW, or variants such as BPSK, as viable digital modes.

Coherent CW (CCW) is a 25 year old Morse code mode that uses tight time and frequency control, very narrow bandwidth signals (less than 10 Hz), perfectly sent

code and very tight CW filters to bring weak signals up out of the noise. Amateur Radio CCW inventor Ray Petit, W7GHM also invented the digital mode Clover. The first ham QSO was by Andy McCaskey, WA7ZVC using a Ten-Tec PM-1.

How does it work? First, the basic CW element, a "dit", is established as 100 milliseconds long (equivalent to 12 wpm). The receiving computer can then latch onto a dit and expect another dit, dah or space at multiples of exactly 100 msec. In other words, the more you know about a signal before it arrives, the less information you need to acquire from the signal itself. This is how we copy plain text Morse by ear. A couple of letters into a word is often sufficient to know, from context, what the word is probably going to be. A couple of words into a sentence is often enough to finish up the sentence. The rest is only validation of what we anticipated.

Secondly, if the receiver filter passband is too wide, the filter will pass through a lot of noise along with the desired signal. On the other hand, if the signal bandwidth and the filter passband are extremely narrow, the amount of noise passed through decreases and the ratio of signal-to-noise is increased tremendously. The effect is similar to raising the power at the transmitter.

Until now this hardware based system, which relies on tight frequency control and detection of varying amplitude, has been difficult to achieve by most hams because the infrastructure didn't exist to support it adequately. With the advent of extremely stable VFO's, GPS for time control and inexpensive microprocessors and excellent software to send perfect keyboard code and do the necessary digital signal processing (DSP) we may see the mode flourish.

Why would anyone want to use an "outdated" mode like CW in this day of computers, packet, Pactor, etc.? Mainly because you can work around the world on 40 meters during daylight hours using only a few milliwatts of power with CCW. You may not be able to hear the signals by ear on an ordinary receiver, but the DSP can bring them up out of the noise so you can easily copy the code by ear.

Early CCW proponent Professor "Woody" Woodson W6NEY told me he used to carry a 40 meter QRPP beacon on European lecture trips. A prearranged set of dits and dahs would allow his wife, who was monitoring in Berkeley, to know if he was going to be on time getting home or whether he would be delayed by a day or two. The weak signal wasn't heard by anyone else.

This time around CCW will probably be reincarnated as Binary Phase Shift Keying (BPSK), a form of radio teletype. Several groups are working on kits to build standardized rigs analogous to the Tucson Amateur Packet Radio (TAPR) TNC's that allowed easy packet radio access. Johan Forrer KC7WW, TAPR moderator for the HF special interest group, is involved with BPSK experiments. G3PLX Peter Martinez, who created Amtor by adding error detection and correction to the commercial SITOR, has joined BPSK nets on 20 meters. Incidentally, Amtor is pretty much obsolete now that Pactor and newer modes have replaced it during the past two years.

The original CCW scheme relies heavily on the fact that two signals with the same 100 milliseconds mark length and space length will stay in lock step indefinitely if they both start at the same time. Accurate timing and element length control are extremely critical requiring tight frequency and time control at each end of the path. This hardware dependent system

is replaced by DSP software control with BPSK.

Receiving CW depends on differentiating the signal from surrounding noise. We can hear frequency and amplitude changes by ear and use those to receive ordinary CW. We are accustomed to thinking of RF signals as having both a frequency and amplitude, but they also have phase relationships. The human ear cannot differentiate phase differences. In fact, quadrature modulation allows us to modulate one signal starting at zero degrees, for instance, and another at 90 degrees on the same carrier sine wave and then differentially detect, or separate, the two signals at the receiver. When the transmitted and received signals are in phase, or synchronized, we say they are "coherent".

BPSK is a modulation scheme which shifts the phase of an RF carrier with respect to a digital bit stream. It requires a simple transmit interface board which mixes a stable audio reference tone derived from a crystal controlled clock with an 800Hz digital signal through a double balanced mixer or an exclusive-OR gate to produce the binary phase modulation and then inputs the signal into an SSB transceiver audio input. The interface board can be built on perfboard for as little as \$10.

The receiver compares the phase of each bit with the phase of the preceding bit to perform the differential coherent (i.e. synchronized) detection. A receive interface board accepts the 800 Hz audio tone from the receiver, performs an analog to digital conversion and feeds the signal to the computer where the software does the rest. A simple 12 MHz AT computer is sufficient to handle the software under DOS control. The shareware, called "Coherent" is used by the low frequency and very low frequency experimenters (LowFERS) all the way up the

spectrum to ham use with lasers. Setting up the software is similar to setting the parameters for a computer modem (start and stop bits, parity and baud rate).

LowFERS are especially interested in raising signal-to-noise ratios since they are restricted to low power using antennas only 50 feet long (including feedline!) on a band with a wavelength of 1750 meters. That's the definition of "inefficient".

Results are best with stable frequency control, but this is nowhere as important as with hardware dependent CCW since we're comparing phase, not frequency or amplitude. Receiving requires setting the BFO to exactly 800 Hz, displaying frequency in 1 Hz steps and having a single frequency reference for internal oscillators. The currently preferred transceiver is the ICOM 706, especially with the optional temperature controlled crystal oscillator, although this is not an absolute requirement.

On-air operation is done with the transceiver in the split frequency mode, receiving in CW and transmitting in SSB up 1800 Hz on the lower side band. Note that the transmitted signal is data, not phone. Bill de Carle VE2IQ produces freeware which allows you to compare your receiver's frequency counter to WWV and apply a correction to accurately set your receive frequency to the standard BPSK calling frequencies, if desired. The software also sets the received CW audio sidetone to exactly 800 Hz.

If this mode catches your fancy you can check the progress of cutting edge work by going to the web site in Aitkin, MN of Lyle Koehler K0LR at <http://www.qsl.net/k0lr/watsbpsk.html>. For schematics, & freeware see Bill de Carle VE2IQ's site <http://www.ietc.ca/home/bill/bbs.htm>. For a BPSK reflector, subscribe to bpsk@qth.net. Thanks to Andreas Junge

KF6NEB for these addresses. Bill de Carle's new program, AFRICA, uses a tracking filter so the signals don't have to be at exactly 800 Hz so long as any drift is at a constant rate. It will run on faster, modern PC's. For PCB's and kits see <http://users.aol.com/part15/readccw.txt>.

George Heron N2APB of Sparta, NJ reports by e-mail that he and fellow New Jersey QRP members Joe Everhart N2CX and Clark Fishman WA2UNN are working on a modular R2/T2 transceiver with integrated DSP board for audio phasing and CCW processing. George calls this "hot stuff!" and says to expect an important announcement at Dayton Hamvention in May. Jim Mortensen N2HOS of Indian Rock Beach, FL has a nifty newsletter at <http://www.n2hos.com/digital/frontpage.html>. "Jim's Gazette" is dedicated to digital modes including CCW and BPSK and should appeal to anyone who likes digital communications.

CCW didn't catch on earlier because it was dependent on highly stable standard oscillators and transceivers at both ends. Some early experimenters went so far as burying oscillators underground in order to control temperature and thus frequency drift. Now, only reasonably stable transceivers and frequency standards are required because of modern computer program development, although results are better if highly stable hardware is used. You don't need special equipment to join in if you can hear the CCW stations (listen for "CQ CCW" in perfectly sent code). Daily QSO's are now routine with unmodified rigs such as the ICOM 706.

There is daily activity on 3591, 7081, 10141, 14081 and 18081 kHz. Some of the same weak signal and QRP groups responsible for getting thousands of new users on the air with simple, inexpensive kit radios and on FM packet with inexpensive TNC's are now working on BPSK in

7035

conjunction with the LowFERS, or very low frequency fraternity. Time will tell if

their efforts will achieve wide spread acceptance of this new (old) binary mode.

The St. Louis Express Antenna

by Dave Gauding, NF0R

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The St. Louis Express and the St. Louis Vertical antenna projects evolved together. Configured as a base loaded vertical the original SLV seemed much more logical when it came time to focus on one design. The then incomplete SLX sort of went away quietly before coming back on the drawing board a year later.

A few feet of flat computer cable, some specialized radials and a tuner can produce a respectable portable vertical antenna covering 10-40m. Here's the story of a little shade tree engineering and how the design evolved.

Square One

The earliest predecessor to the SLX concept is a simple remotely tuned antenna perfectly described as a "Birdical". This is a stealthy folded vertical suspending a miniature birdhouse in order to disguise its true purpose.

Approximately 34' of stranded rubber (or teflon) coated wire is passed over a small diameter tree branch at a height of 20-25'. The wire drops straight down on the opposite side thus justifying the folded description.

A lightweight birdhouse provides modest tension allowing the radiator to gently follow the tree as it moves in the wind. Depending on the diameter of the chosen limb the continuous element could be separated by a quarter-inch or less for up to half its length.

Coated wire serves two purposes. The rubber keeps the folded element from shorting when blown together by the wind and helps it slide easily across branches. Bare wire or magnet wire tends to cut into

the bark a little too quickly and eventually binds.

With radials and a tuner the Birdical functions reasonably well from 10-40m using coax or balanced line. For permanent installations the antenna could be coax fed and pruned in place for a single band.

The design has been tested to 50w output and is difficult to detect when properly installed. For amateurs faced with restrictive covenants it's safe to suggest that the Birdical, while a compromise, is a better option than no antenna at all.

Performance on 40m and 30m is generally good. Signal absorption in foliage seems to diminish performance somewhat on higher HF frequencies. As might be expected the situation improves during late fall and over the winter months.

At this point our portable operators have probably noted that the Birdical is adaptable to their specialized needs in the field. The design has been scaled for 80m though not to 160m. Loading coils can be added to shorten the physical length somewhat. The SLX goes one better on this but I'm getting slightly ahead of myself!

Moving Forward

It only took a few days to develop the Birdical. After several months of casual operating at home and in the field the concept offered enough potential to justify further experiments.

One of the now ubiquitous South Bend SD-20 collapsible fiberglass fishing poles replaced the tree. A single 34' length of #24 stranded hookup wire dropped back down from 20' after passing through the tip eye. The element now hanging in the

breeze was more or less a folded quarter-wave radiator on 40m. On air performance was adequate but visually the antenna was an embarrassment. Selling anyone else on the merits of same would not have been easy.

Recalling several successful folded dipole experiments it was worth setting aside a few minutes to investigate that configuration. A folded 40m radial used under an original SLV quickly found temporary work as the SLX radiator.

These 20' long folded radials are fabricated from 300 ohm twinlead. Start by shorting the far end. One side of the twinlead is notched 14' down from the top. This produces a folded 34' wire and a 6' wire. Both sides of the twinlead are terminated in an alligator clip and fed at the base.

The shorter wire serves no useful purpose when pressed into service as a radiator. Performance seemed unaffected so it was left intact during preliminary testing. I fully expected that such closely spaced conductors would interact resulting in a dud design. Surprisingly, despite such proximity, it did not happen. This would prove to be an accidental yet significant discovery!

The twinlead radiator for the SLX radiator loaded on the seven design bands using homebrew and commercial T-match tuners. Both coax and balanced lines were tried successfully. During testing up to eight folded 40m radials were employed in the ground system.

My enthusiasm for pursuing this project jumped after the first contact on 20m at a full five watt output. Then 30m and 40m stations found their way into the log. Eventually, several Caribbean DX stations arrived on 20m. The solar cycle was right at the bottom at that time so this was encouraging.

The SLV concept was evolving quickly at this same time and eventually

took precedence. Work on the then incomplete SLX design stalled. In the course of a few days it moved to a back burner and soon was simply overlooked.

About A Year Later

By now the St. Louis Vertical concept was in general use. Antenna enthusiasts N0TFI and W6MMA had come forward with significant improvements for the loading coil. The SLV was evolving into a better antenna.

I started looking around for a new portable project and the SLX came back into focus. The folded 40m twinlead radial used under an original SLV went back on the SD-20 pole and a long postponed experiment resumed.

This interim configuration worked once again but the twinlead's sail area presented stability problems for the SD-20 on windy days. The tuned quarter-wave radiator was changed to #22 stranded speaker wire in an effort to streamline the design. On-air performance remained about the same.

Then, hoping that even smaller wire might work, the radiator was converted to two adjacent conductors of #28 stranded flat computer cable. The antenna was loading and logging stations yet the conductors were separated by only .050" on center. At this point, things started to get real interesting!

The SLX concept would soon emerge from limbo in a slightly modified format but for same good reasons attributed to the original SLV. The newer antenna remains independent of external supports while installing and disassembling quickly. This design is also simple, lightweight, inexpensive and covers 10-40m. Experienced portable operators understand such features very well indeed!

Eureka!

Three parallel conductors of #28 flat computer cable were then configured

as a 20' radiator. The overall length was chosen to take full advantage of the SD-20's height. The assembly itself took linear loading to the extreme. This was a classic example of nothing ventured, nothing gained! It turned out to be one of those better shots-in-the-dark!

The final version of the SLX radiator features almost a half-wave of wire on 40m or the lowest design frequency. The arbitrary electrical length seems content on the other bands as well. Resonant points are typically sharp but loading with a wide selection of tuners is straightforward.

The three wire assembly is shorted at the top and fed only through the center conductor at the base. The radiator is cut a little long to provide for a few loose turns along the SD-20. This wrap keeps the wire closer to the pole and helps the antenna fare better in windy conditions. The neat and tidy appearance doesn't hurt at all for stealth or cosmetic considerations.

For those familiar with the recently introduced St. Louis Radials the SLX feedpoint configuration is borrowed from that assembly. The readily-available Radio Shack 270-375 alligator clip (or equivalent) again provides support for the thin ribbon and protects the fragile connection. When the radiator shown in Fig. 1 is properly fabricated it is very durable.

Construction

SD-20-type collapsible poles are hand-made and vary somewhat in length. They can even grow longer in cold weather when the friction joints change diameter slightly. With this in mind builders should expect to adjust radiator length to suit their particular antenna assembly. The following construction technique takes the variables into account:

1. Cut a 21' section of any stranded wire flat computer cable. The life expectancy of solid wire is limited in this application. Peel out three conductors and

separate back to 1/2" from the end.

2. Trim the two outboard conductors back to 1/4" from the end. Strip 3/16" of insulation from the center conductor only. These dimensions are approximate. See Fig. 2

3. Discard the terminal screw from a Radio Shack 270-235 alligator clip or equivalent (with crimpable pre-scored base. Carefully slide the prepared wire into the alligator clip.

4. Position the two outboard conductors just past the inner end of the tubular extension. When crimped the wire ends will bend upwards slightly to prevent shorting against the body of the alligator clip.

5. Gently but firmly crimp the tubular extension with a wide-jaw pliers. Do not crush! Too much pressure will distort the wire insulation and may short out the conductors.

6. Carefully solder the exposed center conductor to the body of the alligator clip. The previously crimped tubular extension will serve as a heatsink and minimize melting of the rubber insulation.

7. Attach the alligator clip to the antenna terminal on the mounting base. Lay the fully extended pole on the ground and determine the wire length necessary to comfortably reach the tip-eye.

8. Strip all three conductors. Short and lightly tin the wires. Thread on a small fishing swivel and solder after looping the wire so the attached swivel assembly moves freely.

The completed feedpoint is now secure but can be better protected from moisture with RTV-type sealant, heatshrink tubing or electrical tape. With reasonable care during installation and storage the assembly will give excellent service. When installing an SLX tighten up on the radiator to minimize sail area. Finish with several loose turns along the extended pole including the base section.



Fig. 1

Alligator Clip



Fig. 2

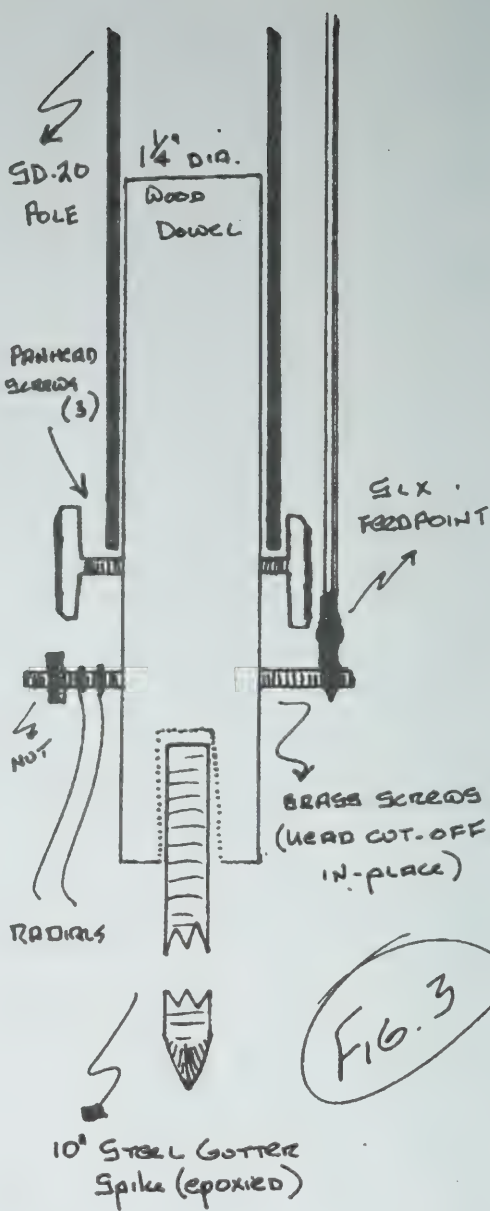


Fig. 3

Armchair Engineering

The SLX places sixty feet of radiator at right angles to the horizon over a ground radial system. Apart from being compressed into only 20' by linear loading that's all there is to it.

The SLX is a remotely tuned multi-band portable vertical. Therefore, SWR and bandwidth are easily managed by the tuner and not major concerns.

The SLX needs an effective ground radial system like any other shortened vertical antenna. Don't even think about squeaking by with just a few wires or a shallow ground rod! You will end up with a portable vertical covering 10-40m. But, it won't be the SLX as depicted in this article.

With the foregoing in mind, St. Louis Radials and the St. Louis Express perform very well together. Three SLR's is a minimum number. Choosing an even number allows a set of two ribbons to be re-rolled at the same time when breaking down the portable station. This places more ground radials under the antenna with about the same amount of effort and simplifies storage.

I use six ribbons under a ground-mounted SLX in portable locations. All seven conductors of the flat computer cable are cut to 16.5'. It is an easily installed and retrieved system. This SLR set provides forty-two radials and about 700' of wire in a compact footprint.

Several spare radiators have been sacrificed in the interest of developing a mono-band SLX. It is certainly possible to do so but the 40m and 30m test antennas typically lost resonance when relocated. Commercial transceivers being broadbanded are better prepared to compensate for such changes. Many simplified homebrew designs expect a good match most of the time and do not adjust quite as easily.

Testing

Field testing of the SLX started at five watts. Power was soon dropped back to three watts and then two watts. On-air results for each test band reflected what should be expected from a simple ground mounted vertical. No contacts were attempted on 17m and 12m due to equipment limitations as well as poor propagation.

The SLX's final testing program consisted of operating CW at one watt output and evaluating an even one hundred contacts subjectively. Activities were split between calling CQ, answering stations and QRP contesting. Past experience shows that consistent performance by a tuned multi-band antenna on its lowest design frequency will generally be repeated on higher frequencies. The SLX is no exception.

Operating Ideas

On-air results seemed about the same when alternating between 50 ohm coax and balanced line. The tuned feeders varied between 450 and an estimated 100 ohms impedance.

For convenience, chose coax such as RG-58 or even RG-174. Backpackers and other users with space/weight considerations may favor the smaller diameter line in spite of higher losses. Twinlead is the lightweight, low-loss and low-cost alternative.

Twinax, speaker-type zipcord and even flat computer cable have been employed as a feedline. The SLX specifications are non-critical so feel free to experiment. The inevitable compromise between performance and convenience will determine feedline choice.

The prototype SLX uses the excellent mounting base that accompanies W6MMA's commercial adjustable loading coils. As this article is written the mounts are not sold separately.

Verne Wright's base assembly for the SD-20-type pole raises the feedpoint slightly off the ground. The radiator is coax-fed through a bulkhead-type BNC connector. This design is simply too good not to use so plan on fabricating your own, if necessary.

A simpler but nevertheless serviceable mount for the SD-20 is depicted in Fig. 3. Like the W6MMA mount this feedpoint configuration can be used with either coax or balanced line. Though not shown either solder lug or alligator clip terminations are suggested for portable feedlines.

The SLX has been tested at 50W output on several bands. More testing is required to define power limitations which may vary with different feedlines.

And More Ideas

Like any other minimalist antenna the SLX should be kept away from trees, shrubs, structures, autos and perhaps even the operator. It doesn't make a lot of sense to give away RF at QRP outputs.

Store the flat cable radiator on a miniature plastic reel. Nest the reel inside a hand-coiled feedline. Place that combination on top of six finger-rolled St. Louis Radials previously packed in a round plastic container. My antenna field kit includes the storage container, SD-20 pole and the W6MMA mount. It is a compact and easily transportable system.

The SLX radiator can also be tree hung using either ground mounted or elevated radials. Depending upon location performance is in the same league as the Birdical described earlier. Once again, RF absorption in foliage at higher HF frequencies should be taken into account when siting the antenna.

The preceding paragraph indirectly underscores the value of portable antennas suspended by collapsible fiberglass fishing poles. Designs such as the St. Louis

Express, St. Louis Vertical and other lightweight antennas can be installed quickly almost anywhere, even after dark. The value of trees as antenna supports is somewhat limited under similar circumstances.

The SLX can be modified to operate on 80m. Choose an unshielded balanced feedline. This will normally increase the total available electrical length to a quarter-wave or more on that band.

When using coax add 3' to each of the radiator's three conductors or about nine linear feet to achieve the same effect. Winding a coil will fit the lengthened radiator to the SD-20 pole.

Elevated coil locations minimize ground losses. Position the coil slightly above eye-level but not lower than the top of the pole's base section. Butt the individual turns together and tape in place. The quality of the ground radial system will be a major factor in determining performance on 80m.

Some Reality Checks

Portability, ease of installation and low-cost were objectives for the SLX from the outset. Coverage down to 40m was an absolute must. These very specific targets have been achieved. Application of basic vertical antenna theory took care of the technical side of this project.

The SLX has not been to an antenna range or computer modeled. However, the final design has been field tested in quite a few fields! An extended five month development period provided opportunities for both day and night operations.

The antenna is a good ground-mounted portable vertical now. There has been no effort to optimize since the design was finalized. As always, improvements are officially encouraged.

Down the Road

A follow-up project describing a free-standing backpack version of the SLX is in draft form. Application of the SLX-type

radiator to other limited space antennas is underway.

Preliminary testing suggests both the SLX and the older SLV are good low-angle

radiators in elevated mountings. A future article will describe simple techniques to get either antenna off the ground easily in portable locations.

The NJ-QRP MicroBeacon *The Design Phase*

The NJ-QRP MicroBeacon

The Design Phase

by: George Heron N2APB, Joe Everhart N2CX and Bob Applegate K2UT

INTRODUCTION

In part 1 of this project series (Spring 1998 QRPP) we presented the Concept and Requirements phases for the New Jersey QRP Club "MicroBeacon." This project is a collaborative effort being done by our club membership to specify, design and construct a low-cost, flexible and completely open keyer/beacon by following the industry-standard techniques of phased development.

By saying that this is an "open project" we refer to the availability and tutorial nature of the software source code used to control the MicroBeacon ... with this software in-hand nearly anyone can

issue of QRPP by presenting full schematic and software details, prototype construction and review of MicroBeacon field usage.

THE BIG PICTURE

The major components of the design, as specified in the project requirements, consist of: (1) the Microcontroller, (2) the User Interface, and (3) the Attenuator. Refer to the system diagram in Figure 1.

Basically the Microcontroller (with paddle input) keys the transmitter, whose RF output is coupled through a programmable attenuator controlled again by the Microcontroller. All of this is under soft-

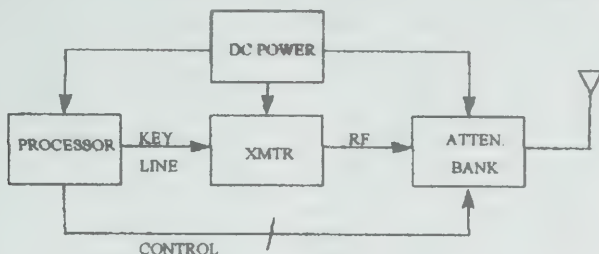


Fig. 1

easily get into the fascinating world of microcontroller programming.

We'll be describing the Design phase in this article installment by building off the requirements specified last time to detail the actual hardware and software design, parts selection and tradeoff considerations made in getting to our first working prototype of the MicroBeacon. We'll wrap up the project series in the following

ware control: keyer speed/memories/options, along with power control of the transmitter being used.

THE MICROCONTROLLER

Selection of the appropriate microcontroller for this project was a tough and debatable topic. This decision caused the most discussion among our membership on the listerv ... everybody has a favorite controller and desire for one vendor

or another. Ultimately we settled on the Microchip PIC family mainly because of its intrinsic ease of programming, for its relative low cost, and for its popularity in many discussion groups and other projects. This educational benefit is of great importance in the project requirements.

Referring to "Figure 1: Detailed Block Diagram", our microcontroller needs to control many devices and serve a variety of demanding functions. We need to have 14-or-so output control lines, be able to read 6 input lines, communicate serially to a host PC, generate a side tone and determine a potentiometer setting through an A/D converter. The microcontroller must be easy to program, reprogram, and reprogram again during the development cycle, for us the design team as well as others who may wish to modify the software later on for their own use, per the source code we provide as a starting point.

We chose the PIC16C74A microcontroller because of its high I/O capacity, its built-in A/D converter port, its built-in serial communications port, its pulse width modulation (PWM) port capability, and for its simplicity of programming. The microcontroller costs about 10 bucks in single quantities, but for all you get (and for all the parts we don't need because of the PIC's integrated functionality) the price is rather attractive. The '16C74A is an 8-bit CMOS RISC, fully static microcontroller in a 40-pin plastic DIP package containing 4KB of program memory and 192 bytes of RAM for keyer and beacon memories. You can see the full spec sheet (288 pages worth!) at the Microchip website:

<http://www.microchip.com>.

Programming the PIC16C74A is also very straightforward. All one needs to do is build/buy a simple programmer (we use the EPIC programming board from Jameco, priced at about \$75) and connect

it up to the serial port of your PC. Using public domain software (i.e., free assembler and downloader!), you can quickly program your own PIC in almost a blink of an eye. Further, a version of the PIC comes with a quartz window in the package allowing for erasure of the program by a UV lamp so you can download your new program to the device and use it again and again. New feature, personalized beacon messages, bug fixes, speed defaults, and many other software customizations become easy as pie to do.

THE USER INTERFACE

Perhaps the most important and visible aspect of a project is the "user interface", or the controls and indicators used by the user while operating the MicroBeacon. We detailed the functional requirements pretty carefully in the last installment, and now we'll take you through just how we realized them all in order to provide a usable unit.

The main way that the MicroBeacon has of communicating with the user is by means of a simple, inexpensive 1-line-by-16-character LCD display. The microcontroller is able to display status (e.g., what memory is playing), prompt the user for input (e.g., "Power level?:") and to display mode, keying speed, and more. We opted for use of the LCD over some less expensive display/feedback alternatives (like LEDs or audible Morse code) because of its inherent greater flexibility. Rock bottom project cost wasn't a high priority requirement, so we selected a flexible display device that was very user friendly.

We decided to use a keypad on the front panel to provide the user with a way to input various parameters and to easily navigate through a myriad of configuration options presented in the MicroBeacon. We considered using a bunch of pushbuttons as in some other popular

memory keyers but we felt that a miniature keypad (like those used in tone pads on HT mics) would be more elegant and flexible in the longer run.

Other user interface devices include a pot for conventional speed adjust (much better than entering digits via the keypad!), and a sidetone generated by a digital pulse train off one of the microcontroller's PWM outputs (with a simple LPF to smooth it out).

ATTENUATOR

If the processor selection was the most debatable topic in the design of the MicroBeacon, then the attenuator was certainly the most challenging and most interesting problem to solve.

The current practice in beacon transmitters seems to be the use of no more than a watt as the maximum power level. This is in keeping with the spirit of QRP in using the minimum power necessary. In addition, since the beacons are often used on the more popular amateur bands, it is important that they not generate excessive QRM. With good antennas 40 meter beacons have been received over distances of several hundred miles during daylight and several times that distance at night, down to low milliwatt outputs.

Beacons operated recently by AA4XX and WA3NNA have used power levels which decrease in steps of 10 dB. On HF the minimum easily discernible difference in power levels is about 3 dB, and since one S-unit is 6 dB, it is recommended that the increments (decrements) be no smaller than 6 dB.

Potential Implementation Methods

Given the requirement of interfacing to an existing transmitter, we explored several methods of power control.

1. Switched Attenuator — Benefits here are that the transmitter need not be modified in any way and the conceptual simplicity is elegant. Disadvantages include:

(a) the need to dissipate nearly the full output power of the transmitter under some circumstances; (b) the possibility of needing a physically large device, depending on the power dissipation, the type of attenuators used and the means used for switching the attenuator sections; and (c) a potentially high power dissipation for the attenuator switches. Probably the best type of attenuator to use is a "pi" type of attenuator composed of carbon composition or carbon film resistors. 50 ohm attenuator pads are very easy to design and will give reasonably accurate results using inexpensive 5% resistors.

The two easiest types of switches are PIN diodes and relays. PIN diodes seem attractive at first glance, but tend to be fairly complicated in a multi-attenuator configuration. Their microsecond switching speed is not needed in this application. Power dissipation can be on rather high, on the order of 100 mW or more switch. In addition, isolation may be only 30 to 40 dB, requiring special techniques if high-value attenuators are used.

Relays may be a better choice when considering a switched attenuator design. They are relatively small. A candidate is the Omron G6H-2-DC-12, available from Digikey for \$4.22 each. It is a dpdt relay that is only 5x14x9mm and has a low operating power requirement of only about 12 ma (1028 ohm coil resistance at 12 volts).

The simplest way of arranging the attenuators to be switched is to put them in cascade, and arrange the dpdt relay to either bypass them individually when powered off, or put the selected one in line when its associated relay is energized. This is identical to the way that manually switched lab type attenuators are built.

A means of reducing operating current for the attenuator even further is to use a latching type relay. This type has two

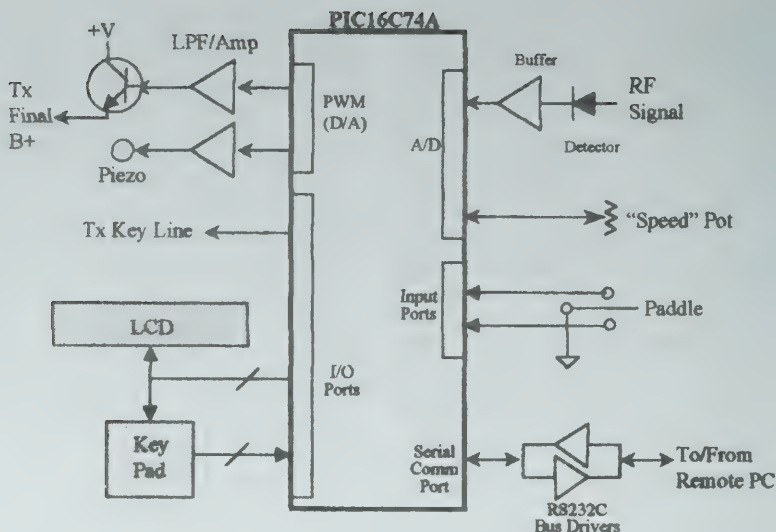


Fig. 2

coils, one to toggle back and forth between the two relay states when pulsed briefly. The disadvantage is additional circuit complexity, but that is minimal. A candidate latching relay is the Omron G6HK-2-DC-12 which has the same dimensions as the non-latching type mentioned above and is also available from Digikey for \$5.22.

2. Adjusting Supply Voltage to Set Output Level

RF output power from a class-C amplifier is approximately proportional to the square of the DC supply voltage. Thus an output stage that supplies 5 watts at 12 v DC will produce about 2 watts at 7.6 volts and 1 watt at 5.37 volts.

12V	5W
7.6V	2W
5.37V	1W
3.8V	0.5W (-10 dB)
1.7V	0.1W

For a 5 watt transmitter, pretty good output control can be maintained down to about 100 mW. DC control can be easily accomplished by means of an integrated circuit linear voltage regulator and switched resistors to set the voltage. And

power levels can be accurately calibrated for a given transmitter using switched potentiometers and fairly good stability and repeatability are expected.

Another Method: Ingenuity Strikes!

The approach we ultimately settled on for our first prototypes is a creative variant of the pulse-width-modulated technique. We use a built-in capability of the PIC (i.e., its PWM output pulse stream) and filter it to produce a surprisingly clean "D/A" analog voltage which feeds the base of a series pass transistor, which in turn provides a regulated and variable voltage to the final amplified of the transmitter. This "emitter follower" transistor stage is the same technique used for voltage regulation in linear power supplies, but in our case we're providing a computer-controlled variable voltage to the transmitter's power amplifier stage, thus providing computer-controlled power output!

As an added benefit of using a microcontroller in the heart of this system is that we can "close the loop" to ensure that stable and accurate power levels are being transmitted. We added a diode de-

tor to monitor the transmitter output - when buffered/amplified it provides an indication to another of the PIC's A/D inputs regarding transmit power levels ... voila, a built-in and computerized power meter to boot!

Note that by using this technique of power control we infringe on one of the project requirements ("must interface to a standard, unmodified QRP transmitter") by forcing the need to separately control the voltage to the transmitter's power amp. This tradeoff was deemed acceptable by the project manager (K2UD) as it provided an elegant balance to the overall system simplicity, cost and functionality.

NEXT TIME WE MEET ...

Well, that's it for now. We've given a general overview of the MicroBeacon de-

sign, major component selection, and some of the specific paths we followed as well as several we could have gone. We felt that these alternative directions would be of much interest as the ultimate design we're providing.

Next time will be the final installment which will delve greatly into the software design, full schematic details and operator usage in the field with prototypes built by a number of club members.

Stay tuned to the NJ-QRP website (<http://www.njqrp.org>) for periodic detailed updates on the MicroBeacon, as well as to view to complete requirements specification and design documents, additional diagrams and photos of the project prototypes thus far. 72, George Heron N2APB (g.heron@dialogic.com)

Building the KD1JV LED Keyer

By Jerry Henshaw, KR5L

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I purchased one of the LED Keyer kits from Steve Weber, KD1JV at this year's FDIM at Dayton. I had a blast at Dayton this year and am looking forward to next year. However, I made the mistake of walking around the vendor area with Doug Hendricks. He had also purchased a LED Keyer kit and caught me in a moment of weakness and persuaded me to write this article on my method of constructing the kit.

I built the keyer in my room at Days Inn South. The kit went together without a hitch and worked right out of the box. However, there is a typo in the instructions - step 7 C1 should read C3 and in step 8 C3 should read C1. The parts placement drawing is correct.

I didn't want to use the harsh/piercing Radio Shack piezo buzzer as the side tone oscillator as suggested by Steve We-

ber. Whilst wandering around the Hara Arena I stumbled upon a Rainbow OSC-2 code practice oscillator kit for \$4.95. This is a simple NE555 kit with a very thin 8 ohm speaker. The price was right! I had no problem interfacing the OSC-2 to the LED Keyer.

I modified the OSC-2 by adding a 500 ohm pot in series with the speaker lead to serve as a volume control for the side tone. I also paralleled a .01 uf cap across C2 (timing cap) to lower the side tone to a more pleasing note. I shorted the "key" pads together with a cut resistor lead. Instead of keying the oscillator with a key, I wired the + VCC to the "+V" connector on the LED Keyer. The - (ground) terminal connects to the "SD-Tone" terminal on the LED Keyer. The Side Tone circuit of the LED keyer applies power to the OSC-2. That is all there is to it!

I first tried a Radio Shack 6 volt lithium battery and a "N" battery holder to power the keyer and side tone oscillator. The battery only lasted about 3 days in relatively heavy use with the side tone oscillator. I replaced the 6 volt cell with a standard 3 volt lithium camera battery. The volume is lower on the side tone oscillator but adequate. I couldn't find a battery holder locally for the 3 volt battery so I just soldered the power wires directly to the battery used double stick foam tape to hold the battery in place. I suspect this battery will last considerably longer due to its larger size and mah rating. I used a SPST toggle switch to turn the side tone on and off.

I mounted my unit in a custom built ABS plastic sloping panel box (ala Bill Jones). The completed unit fits in the palm of my hand and is very light weight and therefore perfect for field or mobile use. The keyer works as described in the documentation.

Steve uses a clever method of editing characters entered in the two message buffers. As you enter characters into the memories, the display will flash "-." to indicate proper character spacing and will flash "SP" to indicated a space between words. If you make an error entering a character, simply rotate the speed control counter-clockwise until a "BS" is shown on the display indicating backspace. You can continue rotating the control counter-clockwise as many times as needed to erase the desired number of characters. Simply rekey the errant character and continue with your message. A really nice feature of this keyer is the ability to put either message buffer into loop or beacon mode. Steve has provided a special edit feature to insert multiple spaces (to give more time delay before the loop repeats). Simply rotate the speed control in a clock-wise direction until a "SP" is shown on the dis-

play indicating an extra space has been added to the message buffer. You can continue to add spaces in this manner until the desired delay has been reached. There is a total of 86 character memory locations shared between Memory 1 and Memory 2.

The unit can be operated in either Mode "A" or Mode "B". The speed range is 8 to 35 wpm in 1 wpm steps. The speed control is also unique in that Steve uses a mechanical encoder instead of a potentiometer for this function. The control is freewheeling (no stops) thus ensuring absolute linearity in controlling speed and editing functions. The keyer has a user selectable "Training Mode" that will flash either "-." or "SP" on the displays to aid you in sending correctly timed code. Simply time your sending to the display and bingo — perfect code. You can easily disable this feature to conserve power.

The keyer will automatically go into sleep mode after about 7 minutes of inactivity. The keyer draws only 3 micro amps in this mode. Pressing the Dash paddle will wake the unit. All memory and user settings are maintained during sleep mode. Since the current drain is so low, I didn't bother to put an on/off switch on my unit.

I am very pleased with the keyer and highly recommend it to anyone who sends between 8 and 35 wpm or needs a nifty beacon generator.

72's Jerry KR5L

[Check with Steve Weber, KD1JV, 633 Champlain St., Berlin, NH 03570 for kit availability and information]

The NorCal Dayton Building Contest

by Doug Hendricks, KI6DS

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This years Dayton building contest consisted of three division, the NorCal K8FF Paddle building contest, the K5FO Unlimited contest, and the NorCal 2N2222 Transceiver Contest.

Judging was held on Saturday night at the hospitality room sponsored by ARCI. Judges for this year's contest were Dick Pascoe, G0BPS, Wayne Burdick, N6KR (who came up with the 2N2222 idea), Wayne Smith, K8FF (the designer of the K8FF paddles), and Gary Breed, K9AY, well known author, publisher and designer.

The results of the paddle contest were:

First Prize: KC5FMZ, Robert Sorge

Second Place: KR5L, Jerry Henshaw

Third Place: N8VAR, Ron Doyle

The quality of the work was unbelievable, and the winning entry received a prototype of the K8FF paddles built by Wayne Smith himself, and donated by Wayne. K8FF has now become a very recognizable call and Wayne says that it is a thrill to call CQ and have someone come back to him and say that he is using one of Wayne's paddles. It was an excellent project, and it far, far exceeded my expectations.

The 2N2222 competition was just amazing. I could not believe the craftsmanship of the entrants. First prize was won by Jim Kortge for a 20 meter transceiver, and Jim is writing up a very extensive article that will be published in the fall issue of QRPp. He modeled every section of the rig with modeling software, and just did an absolutely beautiful job of building and documenting his work.

Second prize went to Roger Traylor, for his NP0 40 meter CW transceiver. It utilized a phasing method to reject the un-

wanted sideband, and was a most unique entry. Roger's design is featured elsewhere in this issue.

Third prize went to James Roberts, NC9H for his 20 meter CW/SSB/AM transceiver. James' rig will also be in the fall issue, as I have not had time to redraw the schematic.

Last year Chuck Adams announced that he would sponsor the unlimited building contest. Actually I announced it and named it after Chuck, and then told him that he could pay for the prize, since the contest was named in his honor. We have had an ongoing battle to cost each other money over building contests over the years. I still remember the year that Chuck decided that we had a 7 way tie for third place, and I had to come up with 6 more prizes.

The judges decided that the winner was Roger Traylor's design in the unlimited class and that Jim Kortge's design came in second. I didn't understand the reasoning, but they had an explanation. Third place in the unlimited division went to Howard Kraus for his spy radio. Howard has an article in this issue on the spy radio.

Many of the entries didn't win prizes but were worthy of one. I have included several of the designs in articles, including Robert Freiss' amazing 2 transistor transceiver and his 10 transistor 5 Watt power amp. Also, Sashi Kumar, AD6CR, deserves mention of his entry. Sashi found out about the contest late in April, worked feverishly to finish his design, and even though it was not quite finished, sent it in anyway. He had fun building, and he wanted to share his project with the rest of us. Tha is what QRP is all about.

We all benefit from building and design contests, because excellent articles are generated for all of us to read and learn from. Hopefully, you will enter the building contest this fall at Pacifcon. There will again be 3 divisions, with some changes in the 2N2222 contest. The 3 divisions at Pacifcon are:

K5FO unlimited contest. You may enter anything that is qrp related that you have built since Pacifcon of last year.

NorCal K8FF Paddle Contest. NorCal K8FF paddle kits that have been put together and finished will be judged on presentation and appearance.

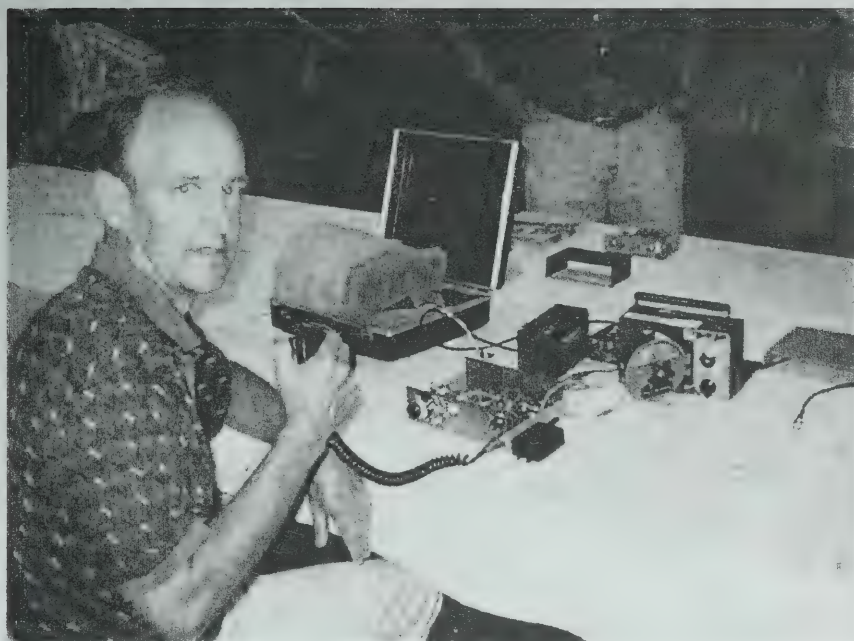
NorCal Transistor Transceiver Contest. The object of this contest is to build a transceiver using only transistors. You may use as many as you wish, and any kind that you wish, as long as it is a transistor. IC's are not allowed. Passive mixers are al-

lowed. TUF-1's, SBL-1's etc are ok. Voltage regulators are allowed, as long as they are the 3 pin variety. In this contest you may use NPN's, PNP's, FET's, MosFet's, etc. The objective is to build a transceiver that is not made of little black boxes (IC's). LED's are ok, as are diodes.

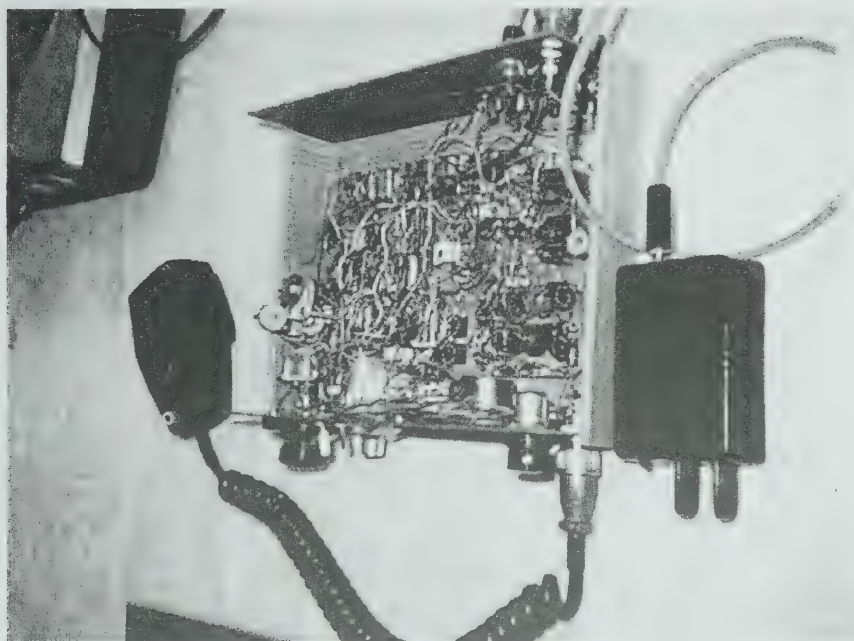
I would like to thank the prize donors: ARCI, Almost All Digital Electronics, American QRP Key Company (Gil Kost), Ade Weiss, Paul Harden, the KnightLights, Wayne Smith, and NorCal. I would also like to say a special thank you to the judges, Wayne Smith, Wayne Burdick, Dick Pascoe, and Gary Breed. The job was immense, and you did a very commendable job. Thank you. And last, I would like to thank everyone who entered, without you we wouldn't have a contest. Keep up the good work, and keep burning solder. 72, Doug, K16DS



KC5FMZ's winning entry in the NorCal K8FF Paddle Contest



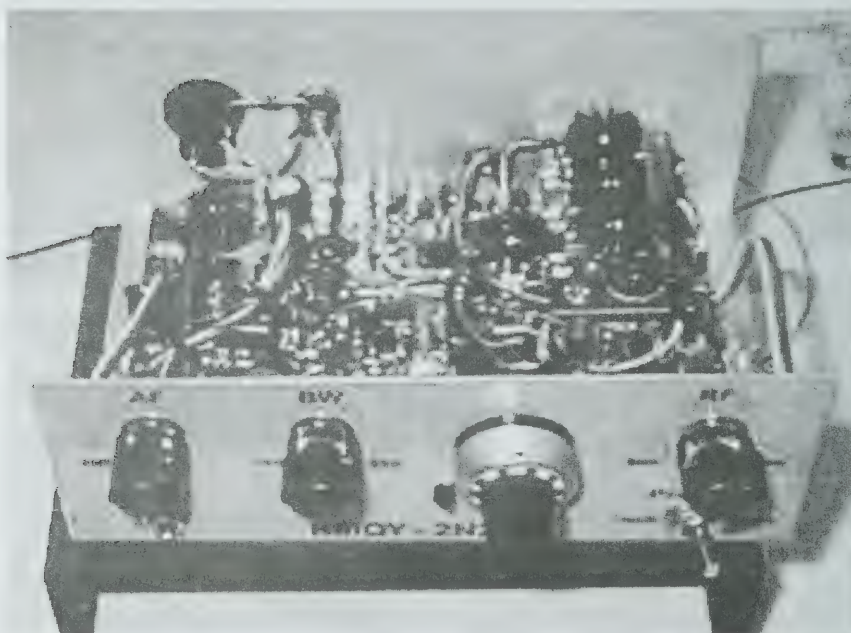
Jim Roberts, NC9H and his third place 2N2222 entry



A closer look at Jim Roberts, NC9H, 20 meter transceiver



The first place entry in the 2N2222 contest by Jim Kortge



Front and Interior view of Jim Kortge's First Place 2N2222 Rig

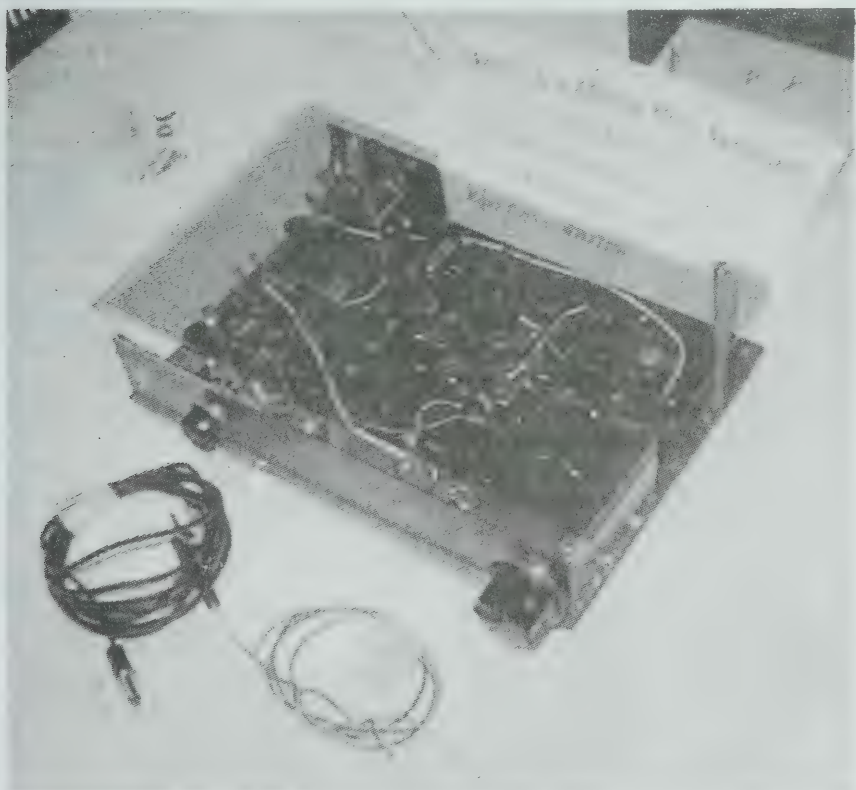
My 2N2222 Contest Entry, the "NP0"

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The 2N2222 design contest thought up by Wayne Burdick, N6KR, was the perfect vehicle to try out some phasing rig ideas that had been brewing in my mind for some time. I have been interested in the phasing technique for many years despite their shortcomings and the difficulty in getting adequate opposite sideband rejection. However, my attempts to build these receivers have led me down some unusual paths over which the learning experience was very rich. I suppose its the "road less traveled" effect. I highly recommend taking that path.

While creating this rig, I tried so many ideas that didn't work. Honestly, I completely gave it up for lost 4-5 times. But each time I'd get a 3am wake up call from deep in some brain wrinkle that would bring it back from the grave. My wife would stumble into the kitchen and give me that "what in the heck are you doing at this hour" look and then go back to bed wondering if I had lost my mind.

This rig remains a work in progress. The receiver sounds great as it is. But, as a typical engineer, I still want better performance. I thought I could achieve a 90db



SFDR; missed it by 10db. The QSK still thumps too much for me at full volume. The keying waveform could use some tweaking. So, here is a good place for you to start, and improve what I've done. I already have several plans for it in mind.

"NP0" Description

The "NP0" is a 40 meter CW transceiver. "NP0" is short for New Phasing rig, version 0. The receiver uses the phasing method to reject the unwanted sideband. Maximum power output at 12.6v is approximately 1W. The design uses 21, 2N2222-type transistors. Full break-in operation up to about 30 words per minute is supported.

VFO and Buffer

The VFO design is similar to those described in SSD[1]. A 4.7v zener diode provides voltage regulation for the VFO and varactor tuning circuit. The low operating voltage was used to reduce component heating that would cause drift. The frequency determining capacitors were a mixture of polystyrene and NP0 caps. Tuning is accomplished with a surplus 10-turn pot. Since this is a DC receiver, the VFO must be well shielded from the front end to prevent self-detection(microphonics). Therefore, the VFO is contained in its own brass box fashioned from hobby brass.

The VFO output is buffered by a two transistor amplifier taken from a KK7B[2] design and is modified to provide extra output. The output from this stage was approximately +11dbm.

Power Splitter and Phasing Generator

Following the VFO buffer, a power splitter (T2 and R12) divides the VFO energy between the phasing generator and the PA driver. The power splitter and phasing generator are taken from a KK7B[3] article. Fine tuning of the quadrature phase is provided by variable inductors L2 and L3. This proved to be a much easier way to fine tune the phasing adjustment that by

squeezing the turns on a toroid as suggested by KK7B. The null in the opposite sideband is quite sharp. A proper null is attained by alternating the L2/L3 setting and the phase amplitude adjustment pot, R63. Upper sideband is selected so that when transmitting, the VFO is offset down in frequency so that it will be at the zero beat.

Product Detectors

The I and Q channels have separate product detectors. They are singly balanced mixers, formed from a differential pair with the LO injection applied to the constant current source.

A beta measuring circuit was used to match the upper differential transistors. Direct measurement of beta was not required, but simply matching emitter currents in the vicinity of 10ma was adequate. Most of my 2N4401's had betas of 120 to 140. I used 2N4401's in the product detectors because of their lower noise figures at audio.

To achieve higher dynamic range, 4.7 ohm emitter degeneration resistors were added to linearize the differential pairs. A standing current of 9mA in each collector of the differential pairs further reduces distortion. I would have increased this to 15mA or more except for the 70mW power limitation of the audio output transformer. Audio transformers (T9, T10) are used to maximize detector gain and to provide a low driving impedance to the audio phasing networks. The balanced output also helps reject any AC hum or microphonics.

Some folks consider audio transformers to be "large and heavy", "costly", and "hard to find". The transformers I used may be found in Mouser or Digi-Key catalogs, cost about \$1.50, are smaller than my thumb nail, and weigh about the same as an SBL-1 mixer.

Audio Phasing Network

A passive audio phase shift net-

work[4] is used. I used 1% tolerance resistors and 2% polyester film capacitors. The 0.028uF value was obtained by paralleling a 0.027uF and a 0.001uF capacitor. No matching of components was performed.

The center tapped output of the product detector transformers provide the 180 degree phase shifted inputs for the networks. A high gain audio amplifier for each channel (Q16, Q17) follows the phasing network to offset its considerable loss. A balanced output is again obtained via a audio transformer. The high impedance primary of the transformer allows for high gain and cancels out any hum on the supply line. I and Q channel amplitude imbalance is adjusted out with R63, a 100 ohm, 10-turn trim pot.

Audio Filter and AGC

Main selectivity is obtained with a 7th order, low pass elliptical filter with 850hz cutoff[5] and high pass filter with 300 hz cutoff. I used hand wound pot core inductors and polyester film capacitors to make the filter. The pot cores are actually easier to wind than a toroid since they have a removable bobbin.

The use of "store bought" TOKO inductors has become popular for audio filters. However, these inductors are quite lossy. I ran a Spice simulation to quantify the loss. The filter was modeled three ways; ideal, ideal with TOKO series resistance included, and ideal with pot core series resistance included. Referenced to the ideal filter, the TOKO equipped filter had 10db additional loss. The pot core equipped filter had about 1db additional loss.

A relay is used to provide receive muting during transmit periods. I settled on this approach after many, many other approaches failed. To correctly mute a DC receiver without thumps or clicks without opamps or FETs is a real challenge. The

basic problem is that of DC level shifting. Anywhere I tried to simply clamp the audio with a transistor, a DC level shift would be created. With over 80db of audio amplification, the shift would be translated to a "pop" that would blow the headphones off my head.

I found that clamping the input to the audio filter with a transistor, produced a thumpless mute. No level shift occurs since the input to the filter is at DC ground. However, the attenuation was insufficient because the 0.1V Vce(sat) of the transistor could only limit the amplitude to 0.1V. Oh how I wished I could use a FET! Finally, while in the shower (a fertile thinking place) I thought of using a relay.

Audio Amplifier and Sidetone

The audio amplifier is another circuit adapted from SSD[6]. It is followed with a homebrew Class A transformer coupled output driver. Its not running class A for very big signals as the standing current is only about 15mA, but distortion is undetectable up to annoying volume levels.

The sidetone circuit is a phase shift oscillator adapted from the 1995 ARRL Handbook. I really don't like this circuit. I never seems to oscillate at the frequency it should. I wanted to do a LC sidetone oscillator but ran out of time. There has to be a better way.

PA driver, Keying and PA

The PA driver (Q4) is the general purpose gain block described in SSD[7]. The only change to it is that the 3.3k base bias resistor is used to key this stage. The all NPN keying circuit is adapted from a QRPP article[8].

The PA stage is adapted from W7EL's optimized QRP rig[9]. It uses two 2N2222's in parallel (Q5, Q6) as the PA. I added the 1.1 ohm resistors in the emitters to limit thermal runaway. They are made up of two, 2.2 ohm 1/watt resistors.

I was able to get 1.25 Watts of out-

put from only two of these poor little 2N2222s in the TO18 cases and a heatsink. At full output however, I notice that the output power slowly increases as the transistors heat up. I believe this is because the transistor current gain (beta) is increasing with temperature which in turn increases the current which increases the beta. This positive feedback is slowed considerably by the emitter degeneration resistors, but continuous key down at full output would probably destroy the PA transistors within 30 seconds.

Another contributing factor stressing the finals is that the output network that appears as a 50 ohm load. This impedance is consistent for producing a output of about 2 Watts, but is too low for these tiny transistors to operate efficiently. My first rig modification will be to replace the finals with a 2N3053 or equivalent. I have tried this, and the output was a solid and stable 2 Watts.

Construction

The rig was built "ugly" style on a piece of double sided PC board material 6x9 inches. A front and back panel was fashioned out of PC board material and held all the controls (both of them!) and the necessary power, key, antenna and phone jacks. I found a 10 cent piece of tinted plastic at a surplus store and mounted it via 2" standoffs over the circuitry to protect it from my kids, dust and our pet rat "Blaze" who sometimes frequents my radio table.

Other than using Spice to simulate the loss in the filter, I did not use any simulation tools in the design. I don't have anything against these tools, in fact, I make my living maintaining and teaching others how to use Spice and other CAD tools. I relied mostly on pencil and paper, a trusty calculator, a multimeter, and my understanding of how circuits work. I did get to use some fancy test equipment to test my

rig, but that was once it was done.

Performance

I'm probably prejudiced, but the receiver sounds great. Its easy on the ears and a pleasure to listen to. It has the good audio quality that good DC receivers have. I have detected no AM breakthrough, and absolutely no hum and microphonics. I attribute this to a well shielded VFO and balanced circuitry. The opposite sideband rejection is quite good considering the simplicity of the circuitry.

The transmitter works fine and is acceptably rugged when the output level is held to about 750 mW. The keyed output signal is sharp on the rising edge and slow on the falling edge. This needs some attention. The frequency stability is adequate but could be improved if VFO was made an "all NP0" design. Besides, it would be consistent with the name. Also, the sidetone is still at an irritating 1200hz. I gotta fix that before it drives me crazy.

Specifications

Receiver:

Sensitivity (MDS): -125dbm

Spurious Free Dynamic Range: 80db (tested with 20khz spacing)

Receiver Audio Bandwidth: 500hz

Peak Audio Response: 600-800hz

Opposite Sideband Rejection: 30-40db (depends upon audio frequency)

Output: 8 Ohm

Transmitter:

Output power: 1W nominal, adjustable down to 0W

Keying: PA driver keyed, shaping applied, 1ms rise, 7 ms fall

Power Amplifier: Two 2N2222 (TO18 case with heatsinks)

PA Efficiency: 50%

Output Purity: All harmonics are 35 db down from fundamental

SWR Tolerance: Don't push it!, Use 50, non-reactive load or run at 500mw

Conclusion

I would like to thank Wayne Burdick and all those who judged, donated prizes, or had a part in this contest. I hope others will realize that you don't have to have a room full of test equipment or CAD tools to design a rig. Basic tools, clear understanding of the fundamentals, and a willingness to try something new is all you need. Now, get to work and make this design better!

References:

1. Wes Hayward, Doug DeMaw, "Solid State Design for the Radio Amateur", 1977, pg. 34
2. Rick Campbell, KK7B, "A Small High-Performance CW Transceiver", QST, 1995, pg. 41
3. Rick Campbell, KK7B, "KK7B SPRAT Technical Cartoon #1, A Passive Phase-

Shift Network to Cover the Whole Band", SPRAT, Winter 1994/5, pp20-22

4. G.K. Shubert, WA0JYK, "Solid-State Phasing-Type SSB Communications Receiver", Ham Radio, August 1973, pp6-16

5. Ed Pacyna, "QRP Reviews - R1 DC Receiver", QRP-L posting

6. Wes Hayward, Doug DeMaw, "Solid State Design for the Radio Amateur", 1977, pg. 223

7. Ibid, pg. 147

8. Steve Webber, "My 2N2222 Rig Design for the NorCal Dayton Building Contest", QRPp, Winter 1997, pp38-54

9. Roy Lewallen, W7EL, "An Optimized QRP Transceiver", QST, August 1980, pp14-19

[The schematic for this transceiver is in the center foldout section.]

The Spy Rig

By Howard Kraus, K2UD

I had ordered two of the 49er kits in the Summer of 1996. As with many of my projects, they languished on my work bench due to lack of recreational time. My position as an elevator mechanic demands a lot of me, especially after hours. Well time went by and I finally got a chance to put the 49er's together this past year. I did put the toroid mods in place of the molded chokes which tended to clean up the oscillations I was experiencing.

At the Rochester, NY Hamfest, I spotted the miniature keys such as the one I incorporated in my rig. Boy, did they cost me! Each key cost more than the 49er. Danny, K3TKS explained the history of the miniature keys to me at Dayton. The key is a 6B Telegraph Key made by Western Electric. It is one of four keys, numbered 1-4, which are the control keys for the 35D/F Apparatus Test Set made by Western Electric. It was used in just about every central office in the U.S. for setting up and adjusting the wire spring relays for their

proper operate and release currents. Dave Ingram, K4TWJ's book "Keys, Keys, Keys" romantically describes them as railroad detective keys! Although not intended for CW use, they are for all the world constructed like a precision key should be. Adjustable contact spacing, tension, even a shorting bar makes this a perfect CW sending device.

With 49ers and miniature keys in hand, I set out to fulfill a penchant of mine to construct a "spy-type" radio! Now if I could only come up with some type of enclosure that would befit such a use. Remembering back to another hamfest where I had spotted some rather nice looking wooden presentation boxes with flip lids, I was able to identify the gentleman who was selling them. Turned out, he was a local. Two hours later and I was measuring and drilling the boxes. Yes, box(es): I built two of these "spy radios." One for myself, and one which I will present to my 11 year old son when he passes his Novice

license. Really impressed the troops one day when he was 3 years old. "What is G?" His reply, "dah-dah-dit." What a guy!

Soon we will clandestinely gain intelligence on the neighborhood. What flowers are growing in the neighbor's gardens, where is that barking dog, what friend is little sister playing with, when will supper be ready, why are my tools rusting on the lawn. Serious matters of state, these!

I have worked out to 1000 miles with the 49er already. Not shabby, especially when you consider that this was done in the heat of the afternoon when the QRN level on 40M was high. A quarter watt into an end-fed Marconi certainly can go

quite a ways.

The wooden boxes (I like to call them coffins for rodents) may still be available from John Kozlowski, 306 Riverside Avenue, Buffalo, NY, 14207, (716) 875-8538. The boxes didn't break the bank as the miniature keys did. As far as locating the keys, good luck! Dayton had some, and the prices were pure Dayton. Where else have you seen HW-7s going for \$150?

I hope this provides some interesting color for the spy-rig. It really is as much fun to use as it is to look at. Now I have to call control for my new assignment. Hmm, what will it be, a NorCal 20, Green Mountain, SST? 72, Howard Kraus, K2UD

SWITCHED CAPACITANCE AUDIO FILTER plus CW PEAKING SCAF

by Jim Pepper, W6QIF

For those who were fortunate enough to attend the QRPp meeting at the 1997 Pacificon conference, you one of the speakers talk on the advantages of using audio peaking for CW reception. Using this technique, you will find a great improvement with any type of receiver from a Direct Conversion to a modern day superhet. The noise essentially disappears and all you hear are CW signals standing out from the back ground. The following is a project that you can build that will do just that. In addition, for those who have receivers that lack in audio output, this project will also prove worthwhile.

DESCRIPTION

The unit discussed is designed to be used as an outboard module that plugs into the speaker output of your receiver and has an output to connect to a separate speaker or head phones. It is either operated from a 12V source or an internal 9 volt battery. A front panel switch allows either the circuit to be in or bypassed to give normal receiver operation. There are four modes of operation. One, the bypass mode, two, a wide band mode with a corner frequency

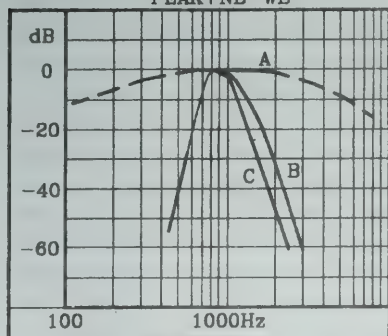
at 2kHz, three a narrow band mode with a corner frequency at 1.1kHz and finally, with the filter in the circuit, the peaking circuit can be activated giving further improvement in selectivity. (See curves in figures 1 and 2). The band width selectivity is obtained through the use of a SCAF (Switched Capacitor Audio Filter) circuit. This type of filter is capable of giving very sharp filter skirts with an attenuation ratio of 48dB per octave. A typical RC network will give only 6 dB per octave.

The peaking circuit was derived from a circuit that was originally designed to give a null in the audio range. It turned out that one half of the circuit could be used as a peaking device. The frequency at which peaking takes place can be adjusted from a front panel control and has a range of approximately 500 to 2kHz.

The filter is built on a PC board obtainable from FAR (1) which in turn is housed in a small instrument cabinet. The front panel mounts three switches, the IN-OUT filter switch, the BANDWIDTH switch and a switch for PEAKING IN or OUT.

An LED is incorporated to indicate

FIGURE 1
PEAK+NB-WB



A FILTER OUT
B WIDEBAND PEAKING IN
C NARROWBAND PEAKING IN

when the power source is on. In addition, the front panel has a volume control and a control for setting the pitch frequency that best suits your hearing requirements.

CONSTRUCTION

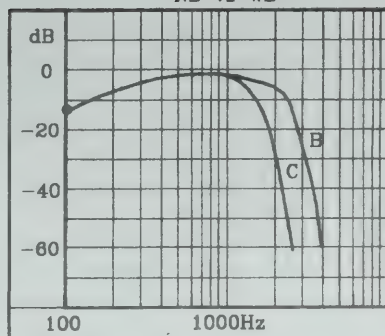
First build up the pc board following the layout drawing and the silkscreening on the pc board. The pots are pc type mounting but the switches will have to be wired in. FIG3

The DC power plug is also of the pc mounting type and is mounted at the rear of the board. I find it is best to mount all of the resistors first, then the sockets and then the rest of the components.

(I always like to use pc sockets for the op-amps for ease in trouble shooting when an amplifier can be at fault. It also allows the checking of voltages at the socket before plugging in the amplifiers.) (If the use of a 9 volt battery is contemplated, snap connectors are provided that also hold the battery in place. The switch (S4) on the rear of the cabinet serves a dual purpose, it acts as an ON OFF switch for the 9V battery and if a 12v source is used, the 9v battery is disconnected. To turn off the 12v supply, remove the power plug on the rear.)

Now wire in the switches etc. following the

FIGURE 2
NB vs WB



directions in the pcb layout drawing FIG 3. You will have to temporarily wire in the phone plug that goes to the receiver audio output for checking purposes. (NOTE: make sure that the wire to the body of the phone plug goes to the ground point on the pc board.)

When the board is completely assembled, I recommend that it be tested outside of the cabinet in case there is some fault that must be fixed. You can plug it your receiver as the source of audio. As I said before, a separate speaker or head phones must be plugged into the output connector. Before connecting to a power source, I would check to see if there is no apparent short between plus and ground of the power connector. If you have a source for the 12v, and it is not a battery, you should use it at this time. Otherwise I would use the 9v battery as a source. A battery source can deliver high currents that can wipe out a pc trace if there is a short some where. Do not plug in the IC's at this time but instead check the voltages on each of the IC sockets to make sure they are the correct value. This is especially important on the Max-95 socket. The voltage on pin 6 be no greater than 9.~volts, and on pin 7, no greater than .6

of 9volts or .6 of 12 volts depending on the power source.

If this check is ok, plug in the IC's and power up the unit. If ok, the LED should turn on.

TESTING

Plug in the phone cable to the receiver and connect the output of the unit to either a speaker or headphones. Turn on the receiver and filter.

With the filter switch in OUT, you should hear the audio coming out of the speaker or phones. Some adjustment of the two volume controls maybe necessary. Proceed to test as indicated below.

OPERATION

Because the circuit has about 3~ dB of gain, the receiver output should be set to a low level and the volume controlled by the units own volume control. This will require a bit of experimenting to get the best results.

I found that, if I set the SCAF volume control at about 1/4 on and the adjust the receiver output level to meet ones audio level requirement, it will give good results. There is essentially no difference in output level between filter in and out.

The peaking circuit has inherently about 20dB of gain, but I have placed an attenuator of about 10 to 1 to reduce the signal from this stage when it is on. The on state is when the peaking switch is open.

To set the pitch control, first set the control in the full counter clockwise position and the BW position in WIDE. Tune in a cw station to the pitch you normally like for copying purposes. Place the PEAKING sw in the ON position. Now adjust the pitch until you hear the signal increase in volume. The adjustment is quite sharp so it must be done slowly. Switch to the narrow band position. If you have modern day high selective receiver, you probably won't notice too much difference, but there should be great difference between

filter IN and OUT. Tune off to the sideband of the signal and notice the difference in noise between filter in and out. Great results are obtained on Direct Conversion receivers because they lack the selectivity of a superhet.

Now tune in a SSB station and note the effect of the filter in and out. It will be quite noticeable on a DC receiver but not as great on a modern day highly selective receiver but still there will be some improvement.

CIRCUIT DESCRIPTION

The unit contains three integrated circuits. One half of an LF353 or a 1458 (IC1) can be used in the peaking circuit. The second half is used to provide a 6 volt output necessary for the peaking circuit as well as one of the voltages for the MAX 295 SCAF IC. The second IC (IC2) is the SCAF IC. The output amplifier (IC3) is an LM380N-8 with a fixed gain of 50.

(I included pc board component mounting holes for a compensating network on the output of the LM380 but in my case I didn't find it was necessary. If the amplifier has a tendency to oscillate, try an RC network on the output. A 0.1uF in series with a 2.7 ohm resistor should work Ok.)

SCAF

The SCAF IC can be set to any corner frequency between 0.1 Hz to 50kHz. I chose 1.1kHz for the narrow band and 2.0 kHz for the wide band. The formula for setting the corner frequency (F_{osc}) is:

Multiply the desired corner frequency in kHz by 50. This determines the SCAF oscillator frequency

To obtain the required capacitance to set the oscillator C(pF)

$$C(pF) = 100,000 / (F_{osc} \times 3)$$

Example:

Desired corner frequency is 1.1kHz

$$1.1 \times 50 = 55$$

$$C(pF) = 100,000 / 55 \times 3 = 666pF$$

I chose 500pF plus a 100pF in parallel as a reasonably close value.

It is my feeling that having any other corner frequencies don't buy you much. I have seen some circuits that use the SCAF with a variable selection for the corner frequency but it only leads to more complex circuitry.. However, feel free to try others if you so desire using the above formula.

ASSEMBLY

If the pc board checks out ok, then you are ready to put it in the enclosure. The cabinet requires a number of holes to be drilled. Make two copies of both the front and back panels (Figure 4 and 5) on a copy machine. They should be 1 to 1. Take one copy and lay it on what is to be the front panel and secure it with magic tape for drilling purposes.. Center punch lightly the center points of each of the indicated holes and proceed to drill them to size.

It is best to start with a small drill first to maintain accuracy of the hole positions. Repeat the process for the rear panel. I used a .5" round file to ream out the hole for the 12 volt opening. You can make an effective reamer by rotating the file in a counter clock wise direction. Turn in a clockwise direction and you will lock up the file.

With the panel drilled, you are ready to mount the second set of copies of the panels. First, the panels must be mounted on a laminating sheet to protect its surface. Cut the panels to size with an inch border all around. Hold the panel down on a flat surface with magic tape on the edges. Cut the laminating sheets to the similar size but with about an half inch border all around. Peel off the backing and carefully place the

material over the panel starting from one edge.

Next, it is necessary to cut out the required holes for the switches and pots. Use a sharp hobby knife and cut carefully around the outer edge of the marked holes. When completed, cut the panels to size. The panels can be adhered to the panel with an adhesive. I used a product called Elmer's Glue Stick • {R}. Any paste would be ok as long as there are no lumps on the surface. Attach to the box panel.

At this time you will have to remove the cable that goes to the phone plug and pass it through the rear panel and reconnect it. Now insert the pc board into the box with the pot shafts going through the front panel. Next mount the wired switches and speaker jack. Later, if you find the switches in the wrong direction, reverse the wiring rather than trying to twist them around to the right direction.

If you have done a good job in drilling the holes, everything should fit properly. You are now ready for the final testing of the unit. Proceed as you previously did and note the panel labeling for the switch action. If everything works, wrap up the project by putting the cover on the box. I think now you can try a 12 volt source if available.


Let me know how this circuit works for you or if you have any questions I will be glad to hear from you.. You can contact me on the internet W6QIF@ix.netcom.com

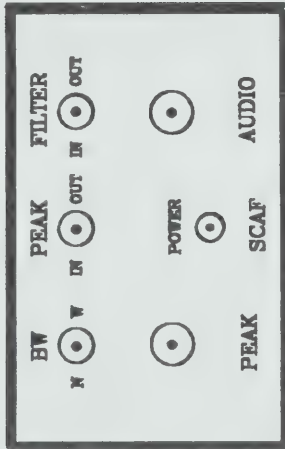
NOTE: The Max295 is available from only one source that I know of DIGI-KEY. For orders less than \$25 dollars there is a charge of \$5. The part costs \$6.02 If you can get four people together to buy the Max295 plus the other IC's you can waive this fee.

OFF BOARD CONNECTIONS



SCALE 1" = 1"

FIGURE 4  1/4 Dia 3 PLS




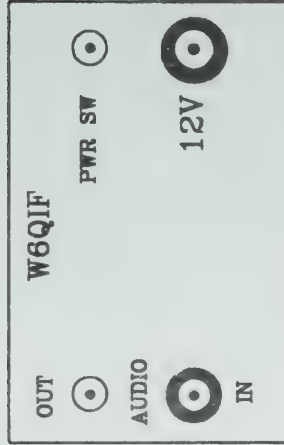



 5/16 2 PLS
 0.20 DIA

FIGURE 5



 1/4 DIA 2 PLS
 1/4 DIA
 5/16 DIA

PRINT SO SCALE IS 1 to 1
 1" = 1"

[illegible]

PC Board	\$7.00
SCAF IC	\$6.02
Instrument Cabinet	\$4.90
Op Amp 1458	\$.49
Audio Amp LM380N-8	
Zener Diode 8.7V	
10K Pot (.99 x 2)	
240pf Cer 5%	
100pF Cer 5% (.15 x 2)	
500pF Cer 5% (.15 x 2)	
.001uF Mylar (.10 x 2)	
0.1uF Mylar (.20 x 2)	

FAR Circuits
DigiKey
DC
DC
DC
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DC

1uF tant. (.30 x 2)	.60	18EM510	DC
10uF tant. (.55 x 2)	1.10	18EK610	DC
47uF 16V Radial Cap	.15	CM16-0047	DC
SPDT Switch (1.50 x 4)	6.00	SW104	DC
Phone Jack 1/4"	1.10	16PJ022	DC
Phone Plug 1/4"	1.25	ME17-1204	DC
8 pin socket (.07 x 3)	.21	T02-08	DC
9 Volt Battery Holder	1.15	1291	DC
LED red (1.25/10)	.13	LR10	DC
620 ohm 1/4W Res. (.05 x 2)	.10	CF25-620	DC
4.7K 1/4W Res	.05	CF25-4.7K	DC
2.2K 1/4 W Res. (.05 x 2)	.10	CF25-2.2K	DC
10K 1/4 W Res. (.05 x 3)	.15	CF25-10K	DC
18K 1/4W Res.	.05	CF25-18K	DC
9 Volt Battery			
Panel Laminate 65059	1.44	C-Line Product	Bookstore
(1) FAR Circuits 18N640 Field Ct., Dundee, IL 60118 Add \$1.50 S&H per 4 boards			
DC Electronics, PO Box 3203, Scottsdale, AZ, 85271 \$4 S&H			
Digi-Key Corp., PO Box 677, Thief River Falls, MN 56701, \$5 S&H			

Project Cabinets

by Jim Pepper, W6QIF
W6QIF@ix.netcom.com

Many home brewers can build electronic projects but lack the facilities to provide a cabinet for their work. Commercial cabinets are available but they certainly are not reasonable in cost. There is one that is readily available and inexpensive, one made for Radio Shack. 270-253 If you have ever used one of these cabinets you probably have found that the aluminum used for the chassis is very soft and difficult to drill. Other wise, for the price, it can't be beat. (\$6.99) I have used them on a number of my projects and on my latest one I feel I have found a solution to making this a very viable unit.

There are two faults that are overcome by applying my modification. The weakness of the aluminum, and the difficulty in trying to drill the panel when its part of the chassis.

What I did was to remove both the front and rear panels of the chassis This

can be easily accomplished by scribing a mark on the panel with a sharp pointed tool (See Figure) to make a break point. Once done, slowly bend the panel back and forth until the panel breaks at the scored point. You probably will have to straighten up the remaining lip and maybe touch up the edge with a file.

The panels will be replaced with 1/16" plexiglass cut to size. This solves the second problem of drilling. The panels are now flat and can be properly clamped for drilling purposes. The panels are mounted to the chassis lips with self tapping screws. A drilling template can be used to mark where the panel holes are to be. Center punch the centers with a very light touch so as to not crack the plexiglass.

You can either spray paint the inside to prevent from seeing into the cabinet (it's best to spray before drilling), or, if

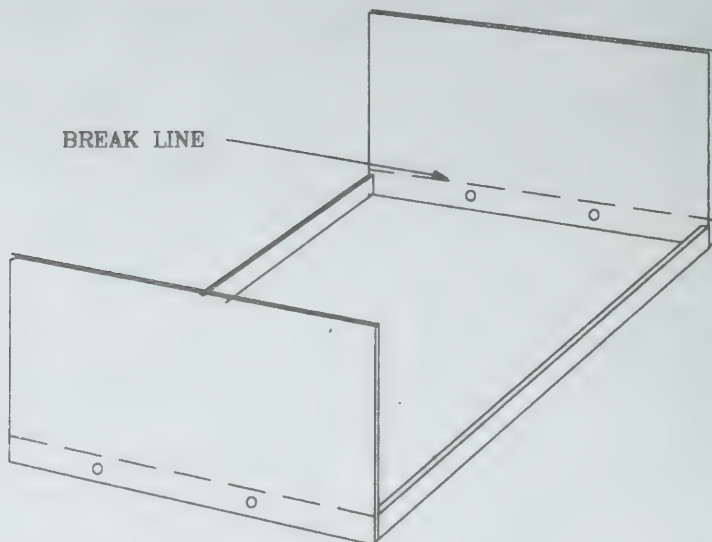
you have a panel layout for the panel, you can adhere it to the panel, or you can adhere a sheet of aluminum foil on its back side. I use laminating material to stiffen the layout material so it lays flat against the panel. (One product is called Panel Laminate 65059 a C-Line Product available from stationary stores.) Holes are then cut in the material with a sharp hobby

knife. The plexiglass can be obtained from stores that handle plastic materials. They will do the cutting for a nominal fee. The panel dimensions are 5-1/8 x 2-13/16.

If you have any questions about the method you can find me at W6QIF@ix.netcom.com

72 Jim

RADIO SHACK 270-253

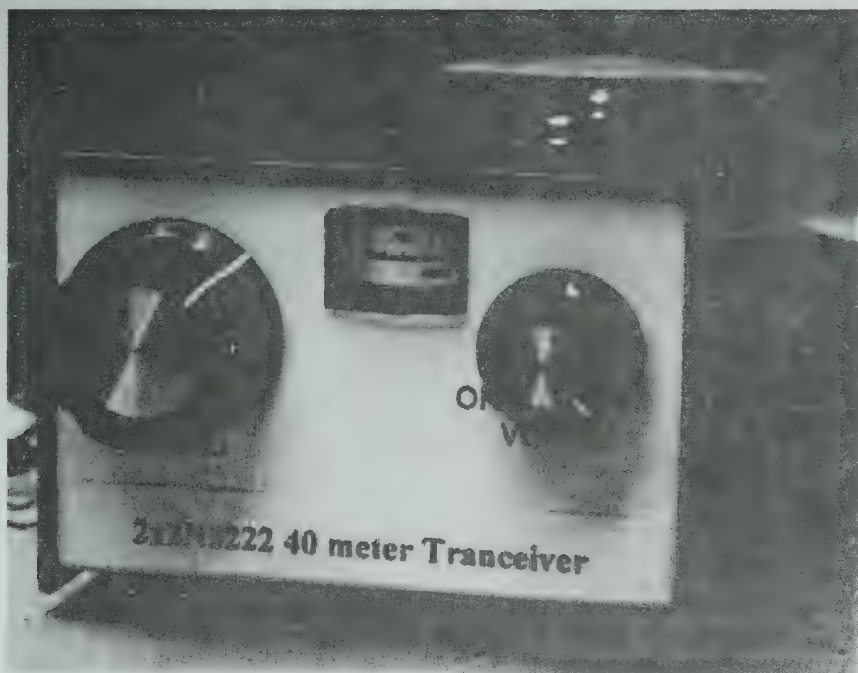


In My Post-Apocalyptic World There Were Only Two 2N2222 Transistors

by Robert Freiss, N6CM
16141 Matilija Drive
Los Gatos, CA 95030

This transceiver was designed with the objective of minimizing the number of active devices, in this case the 2N2222 transistor, while achieving usable performance. The resulting 40 meter CW transceiver uses only two 2N2222 transistors, produces about 700 milliwatts of output, is capable of receiving signals well below 1 microvolt, and provides semi-breakin TR switching. One transistor serves as both a

receiver RF preamplifier and receiver AF amplifier and the other is used as the receiver local oscillator and as the transmitter. The design is all original with the exception of the idea to use two identical crystals in parallel in the VCXO to increase the tuning range. The origin of this idea is unknown to the author, but it works very well. A more detailed circuit description follows.



Robert Freiss' 2 Transistor 2N2222 40 Meter CW Transceiver

Receive Mode

The schematic diagram shows the relays in the receive mode. Signals from the antenna are routed to the base of Q1, the RF amplifier, through a 6 MHz high pass filter (to reduce susceptibility to BC band breakthrough) and a tuned transformer. The amplified receive signal is connected to a diode mixer through a high pass filter that opens a feedback path that otherwise would be present at audio frequencies. The local oscillator signal is coupled to the mixer through the 18 pF capacitor. Recovered audio is connected to the volume control and rerouted through the transistor Q1 again. At audio frequencies output is taken from T2 and connected to the headphone jack. Limiting diodes are provided for comfort when a very strong signal is encountered. The first transistor amplifies the receive signal twice, once at RF and again at AF. Filtering is provided so as not to close

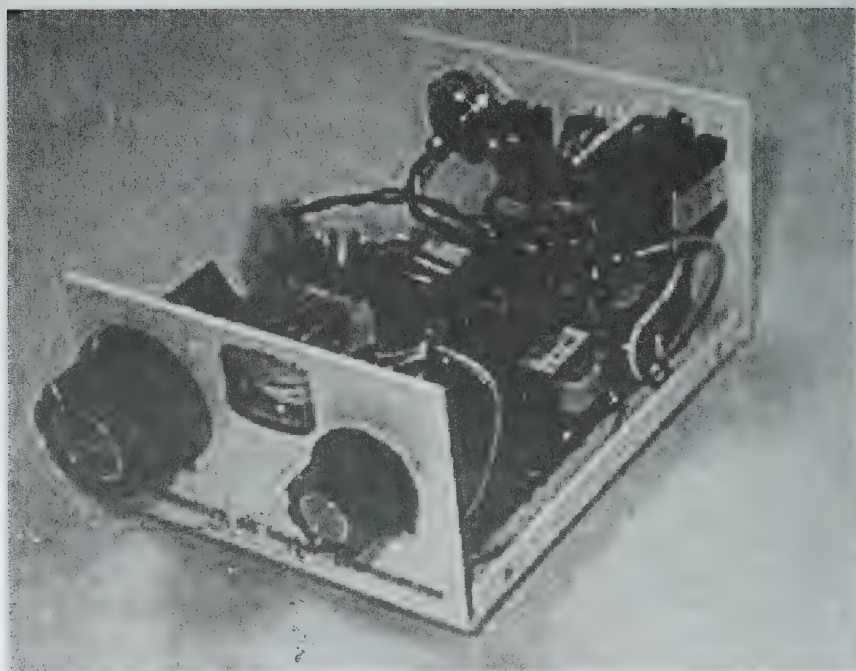
a loop at either RF or AF frequencies to assure stability. Selection of coupling and bypass capacitors was made to limit the AF bandwidth. With the component values shown the 3dB audio bandwidth extends from about 300 Hz to 1000 Hz.

In receive mode, Q2, the VCXO, operates at very low power, about 5 milliamps at 2 volts, to reduce radiated power back through Q1 to the antenna.

Transformer T2 could be eliminated if high impedance headphones were used, however, low impedance "stereo" headphones are more commonly available so T2 is provided to allow the use of low impedance headsets.

Transmit Mode

To select the transmit mode, the key is closed operating K1 and K2. About 1/2 second of delay is provided after the key is opened before switching back to receive



Interior View of Robert Freiss' 2 Transistor 2N2222 CW Transceiver

mode occurs. In transmit mode, the operating point of Q2 is increased, the feedback is adjusted, RF output is taken from the wideband RF transformer in the collector and Q1 is turned off. About 700 milliwatts of output power is achieved with collector current of about 110 ma. In transmit mode Q2 is self-biased by the voltage produced by the current flowing through the diode and 82 ohm resistor connected between the base and ground. Power output can be adjusted over about a 3 dB range by changing the value of the 82 ohm resistor. The output from Q2 is passed through a lowpass filter to attenuate harmonics and is connected to the antenna through the antenna relay. The resulting CW signal is high quality without chirps or clicks. A piezo electric transducer is keyed along with Q2 to produce a sidetone.

An air variable capacitor is used for frequency adjustment in place of a varactor diode in order to maximize the tuning range.

The change in oscillator operating conditions that occurs when switching between receive to transmit also produces a desirable transmit frequency offset. Unfortunately, this offset is not constant across the tuning range. At the high end of the range the offset is about -300 Hz and increases to about -1100 Hz at the low end of the tuning range. At the center frequency of 7040 kHz, it is almost ideal at -700 Hz. Not perfect, but not bad considering the simplicity of the design.

The transceiver is switched between receive and transmit mode by the initial closure of the key. Before the relays can operate, the 1000uF capacitor provided for delay must be charged through the associ-

ated series 22 ohm resistor. The capacitor could have been made much smaller with the addition of another 2N2222, but that would be inconsistent with the minimalist theme of the design. The initial capacitor charging current is approximately 500 milliamperes, consequently, the keying device must be capable of passing this current. If it is not, then the charging of the capacitor may be delayed and the first keyed dot may be significantly shortened or even missed. A mechanical key or a relay or mosfet output keyer is recommended.

Operating Instructions

Connect power, antenna, key, and headphones. Turn on, tune, listen and press the key.

5 Watts From 10 2N2222 Transistors

by Robert Freiss, N6CM

16141 Matilija Drive

Los Gatos, CA 95030

Although not in conformance with the rules for entry in the NorCal 2N2222 contest, as it is not a transceiver, this amplifier is submitted for interest.

This amplifier was designed to provide higher power for 2N2222 CW transceivers in the 200 to 700 milliwatt output power range. It is automatically switched, all that is needed is to connect it to a 12 Volt supply and insert it between the transceiver and the antenna. Just like an ALPHA.

A fan cooled heatsink intended for Pentium microprocessors was drilled with ten holes and ten 2N2222 transistors were press fit into the holes. Individual emitter resistors were provided to assure current sharing and the base connections and collectors connections were all connected in parallel. The combination of the emitter resistors and the shunt inductor in the base circuit resulted in an input impedance close to 50 ohms. Without the input attenuator, only about 100 milliwatts drive is required for full power output. The input attenua-

Performance Measurements

Power output:

Vcc, volts Po, milliwatts

12.0	630
------	-----

12.5	700
------	-----

13.0	770
------	-----

13.5	820
------	-----

14.0	900
------	-----

RF input for 10 dB s+n/n: -110 dBm

Tuning Range: 7033.6 kHz - 7044.4 kHz

AF Bandwidth: 700 Hz.

Current Consumption:

Receive: 20mA

Transmit: 130mA

Spurious Output < -56 dBc (0-50 MHz)

[Schematics for this transceiver can be found in the centerfold section.]

tor is included to allow a drive level of 200 to 700 milliwatts. A collector load impedance of about 12 ohms is provided by the 1:4 bifilar transformer T1. The high impedance point of T1 is connected to the amplifier output through a lowpass filter used to remove harmonics..

Relay K1 is operated by a class B detector connected to the amplifier input. In the absence of a transmit signal, K1 is unenergized and receive signals are passed from the antenna directly to the transceiver. In presence of RF power greater than about 75 milliwatts the relay operates connecting the amplifier into the transmit path. The 470 uF capacitor provides a release delay of about a half a second so that switching does not occur between characters and words. A second detector is connected to the output connector to provide a monitor for output power. This second detector is connected to the front panel meter that has been calibrated in Watts into a 50 ohm load.

Early versions of the amplifier with

smaller emitter resistors and a lower collector load impedance provided by a 9:1 transformer produced more than 10 watts of output. In the end, it was decided that 5 or 6 watts was enough. With the 10 ohm emitter resistors and a 12 ohm collector load impedance the amplifier is very rugged and has been inadvertently operated without load several times without damage.

The described amplifier operates in Class C and is intended for use with CW transmitters. It is not suitable for SSB transmitters.

Performance Measurements:

Pin vs. Pout, $V_{cc} = 13.6$

Pin(Watts)	Pout(Watts)
0.1	2.5
0.2	3.6
0.3	4.2
0.37	4.7
0.5	5.0
0.6	6.0

Power required to key relay: 75mW

Output Spectrum Spurious < -55dBc

[Editors note: The schematic for the Power AMP is in the centerfold section of this issue. In order to make the schematics legible, it is necessary to print them in 8.5 x 11" size. I apologize for the inconvenience of having to disassemble the journal to read the schematics. Doug, KI6DS]

AD6CR 2N2222 40 Meter CW Transceiver

by Sashi Kumar, AD6CR

41808 Corte Santa Ines

Fremont, CA 94539

I started work on my 2N2222 radio design only in April. so I had to come up with a set of guidelines that would allow me to finish the design in time for the contest. Here is what I came up with.

1. A very simple receiver design for CW (there was no time for anything more elaborate.)
2. Good selectivity and sensitivity
3. Good image rejection (if Superhet or Direct Conversion)
4. Operate on 40 Meters with a spread of about 20 kHz.
5. Sidetone
6. Something new and unique

The receiver stages are as follows:

RF Stage:

This is a two stage buffer amplifier, primarily intended to keep the oscillating detector from leaking signals into the antenna. There is a RF gain control at the input of the first stage to attenuate strong stations. I have attempted to keep the gain of this stage fairly low as all the gain that is needed comes from the detector itself.

This stage is inductively coupled to the detector stage.

Oscillating Detector:

This stage gives the receiver the gain, selectivity and CW detection all in one shot. The oscillator itself is a classic Colpitts oscillator. The RF signal from the RF stage is coupled directly into the tuned circuit via inductive coupling on the torroid. There is no regeneration control and strong signals do not pull it out of oscillations. The RF gain control can attenuate strong signals.

Low Pass Filter and Audio Stage:

A RC lowpass filter and two transistor audio stage completes the receiver. The audio amp uses a Radio Shack audio transformer for adequate audio output. A Twin-T audio oscillator gives the transmit side tone.

The Transmitter Stage:

The transmitter picks up RF energy from the oscillating detector and drives a RF buffer stage. The buffer stage drives a pair of parallel connected 2N2222's operating in Class C mode. The output of the

final stage is coupled to the antenna via a low pass filter stage. The transmitter is turned on by keying the buffer stage transistors emitter to ground connection. the keying also causes the receive section to be muted and the side tone generator enabled.

Operation:

1. Turn radio On by plugging in 12 to 13.5 Volts to the power connector.
2. Set RF and Audio gain to a comfortable level.
3. Use Main Tuning dial to receive between 7025 and 7045 kHz.
4. To transmit on the received frequency, tap away on the key.

Bench Test Results:

When the transceiver was completed, I did some quick on the air testing of the receiver and some transmit measurements on the bench.

Receiver:

The receiver is very sensitive and selective. I compared the received signals with my Yaesu FT-920. Most of the stronger CW stations heard on the FT-920 could be copied on the 2N2222 radio. The RF gain is effective only with the very strongest stations and had to be turned up for most other signals to a maximum position. The audio level is high enough, but could be higher. The tuning control runs smoothly between 7025 and 7050 kHz. The receiver is stable and the VFO heard on my FT-920 did not drift more than by about 100Hz. The selectivity is quite remarkable for a radio this simple. I am thrilled with its performance.

Transmitter:

The transmitter output is not a perfect sine wave coming out of the low pass filter. That was a disappointment. I need to work more on the drive for the final transistor and the low pass filter. I tested the output spectrum on a spectrum analyzer and found that the worst case harmonic was

only 14dB below the fundamental. Certainly not good enough. I unfortunately ran out of time since I started the project only in late April. When it comes back from Dayton, I'll fix the output.

Sidetone:

The sidetone on keying seems to be adequate. It does sound a bit raspy. I need to look at the circuit some more.

Keying Circuit:

Works like a charm. The transistor switch scheme seems to work just fine. I need to turn the RF intermediate stages off as well and not just the input. (Again, more work to be done on return of the rig from Dayton.)

Overall Performance:

There is a problem with my design. The receiver is slightly detuned by the input loading on the VFO when in receive. When keyed, the RF section is disconnected from the antenna and this causes the VFO to be off from the receive frequency. When using a dummy load, this was not too bad, but with a real antenna, the shift was not acceptable. I believe I have some ideas on how to improve on this, but I have run out of time.

Conclusion:

I have had a wonderful time with this design. I thank Wayne for his wonderful idea and I want to thank Doug Hendricks for allowing me to send this entry in. Thanks guys, I know I don't have a winning entry, but I sure had fun. I would encourage this form of a receiver though. It is quite remarkable.

Acknowledgements:

The RF buffer section and the side tone oscillator are similar to the one in the 1978 ARRL handbook. The rest of the circuit is quite generic. Enjoy. 72, Sashi, AD6CR

[Editors note: The schematic for the AD6CR Transceiver is in the centerfold section of this issue. In order to make the

schematics legible, it is necessary to print them in 8.5 x 11" size. I apologize for the inconvenience of having to disassemble the

Solving a Problem & 2 Mod's for a Wilderness Sierra/KC-2

by Arjen Raateland, OH2ZAZ

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When NorCal did the field test edition of the KC-2 keyer/counter/meter module it looked so good that I ordered one for my Sierra immediately. As I already had a KC-1 in my rig the completed KC-2 sat in a drawer for quite some time before I ordered a new matching front panel from Wilderness Radio.

After a while I noticed that there was sometimes a slight warble and a ticking sound on the received signal signals. The repeat rate of the ticking sound depended on the display mode that the KC-2 was in, S-meter or frequency. Wayne Burdick, N6KR, explained that the warble finds its cause in a trick he had to resort to in the design of the KC-2. If you look up the schematic, you can see that the VFO signal is buffered by a two stage amplifier and then fed to TWO pins on the PIC. One of these is used as the input for the counter, but the other is actually an output, whose signal - some kind of square wave, no doubt - not only does its intended job, but also manages to work its way back through the two-stage buffer amp all the way to the VFO itself which it modulates very slightly. It just shows how sensitive a VFO can be to outside disturbances.

At first the warble wasn't all that objectionable, but when I started wondering whether the warble might also be present on my TX signal, I decided it was time to get rid of it. A number of replies to a message on the QRP-L mailing list suggested making the coupling cap (Cv) between Si-

journal to read the schematics but it is the best way that we have of doing them. Doug, KI6DS]

erra VFO and KC-2 as small as possible. Dave Meacham, W6EMD, pointed out he had published a short article in QRPp of Dec. 1996 (p.59) about fitting a KC-2 to a Cascade that provided me with a further suggestion.

I also had some additional ideas for modifications for the combination of KC-2 and Sierra waiting to be tried out, and I mustered courage to disassemble the rig once more and get rid of the warble.

The VFO coupling cap (called Cv in the KC-2 manual) was still 10 pF as it had been with the original KC-1. To find the lowest possible value for Cv I replaced it temporarily with an 8 pF trimmer cap. Playing with the trimmer cap I found that the value suggested by most respondents (4 pF) would cause the counter to stop counting properly.

As I needed to remove the KC-2 from the front panel to fit two new wires for the two mod's described below, I took the opportunity to do what Dave's suggested in his article. Dave replaced the coupling cap (C8 on the KC-2) between the two stages of the VFO buffer amplifier in the KC-2 with 100 pF. It originally was 22 pF and I made it 82 pF, because that is what I had handy. You'll have to open the 'sandwich' and bend the backside board away from the display board to get at capacitor C8. If you don't have the tools to desolder C8 it would be a sound strategy to add the extra capacitance in parallel with C8 on the bottom side of the board. Then, with the larger

C8, I used the trimmer cap again to find out the lowest value for Cv at which the counter would still work reliably. I settled on a fixed ceramic NP0 capacitor of 4 pF for Cv. No more warble.

In my Sierra the connection from the VFO to the KC-2 consists of a short piece of sturdy hookup wire (stranded, Teflon coated). Some respondents to my QRP-L message had suggested that replacing the connecting hookup wire from the Sierra VFO to the KC-2 with miniature coax might help. However, 10 cm of RG-174 has a capacitance of ca. 10 pF, which together with the 4 pF coupling capacitor will constitute a capacitive divider. This is certain to reduce the effective VFO signal to the input of the KC-2. Because of this consideration and because I had fb results with the hookup wire I actually never tried the coax.

Now to the other modifications.

1. Using the AUX output of the KC-2 to temporarily switch on the side tone oscillator during reception.

The purpose is to provide an accurate reference for tuning. Even if your rig is properly aligned, your hearing may not have a perfect memory of what the signal pitch should be and AGC action makes it hard to locate the peak in the RX bandpass. Accurate tuning is still required if you want the TX to be exactly on the same frequency as (=zero beat with) the other station. This mod makes it possible to beat the detected audio signal against the sidetone. It works best on headphones.

It is necessary that the rig's RX and TX carrier oscillators (the oscillators governed by crystals X6 and X7) and the

sidetone oscillator are carefully aligned. This is explained in the Sierra manual in some detail.

Note that the original Sierra by NorCal doesn't have a separate sidetone oscillator, so this mod won't work with that rig.

The modification itself (see figure 1) is very simple to do. A MOSFET 2N7000 (I used the European equivalent BS170) controlled by the AUX output of the KC-2 pulls the lower end of R6C to ground through a series diode. After having drawn the mod into the Sierra circuit schematic it is easy to see that this action of the MOSFET duplicates the key down action as far as the sidetone oscillator is concerned. The two diodes (D3 and the one from fig. 1) form a logical OR gate isolating the key line and the MOSFET switch from each other. The circuit will also work without the diode, but in that case the sidetone activated by AUX is slightly different from the sound during key down.

R6, a resistor network, sits on the left edge of the PCB in the middle. Locate pin 5 counting from pin 1 which is marked with a square PCB island. Following the tracks on the underside of the board a suitable clear space for the MOSFET and the diode can be found near the threaded support for the band module. A suitable ground point nearby is marked 'G' on the top of the board. I fixed the MOSFET to the board with hot melt glue to prevent the wire to the KC-2 from pulling the MOSFET away.

NOTE: Holding the MOSFET with the wires towards the viewer, the flattened side of the case up and going from left to

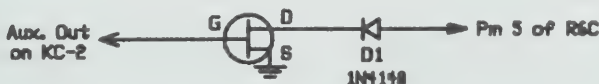


Fig. 1

right, the pin-out is DGS for the BS170 and SGD for the 2N7000 (and the BS170P) SGD.

Disabling the TX during message recording without directly switching an RF signal.

Because this circuit doesn't switch any RF signal directly, there is no potential for affecting the normal operation of the rig. The MOSFET also doesn't need input current like a bipolar junction transistor.

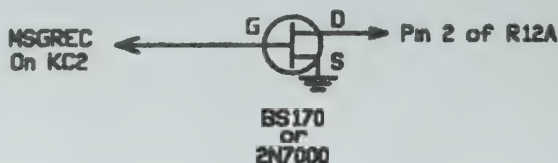


Fig. 2

Figure 2 shows the second modification, which is simplicity itself having a part count of only one. In this case it is the MSG REC signal that is used to control a MOSFET switch. When a message is recorded the MSG REC signal will be 'high'. As long as the gate voltage is 'high' (higher than ca. 3 V) the 2N7000 MOSFET will provide a short to ground for the keying signal at the point between Q8 and Q9 in the keyline buffer amplifier.

This prevents the TX driver stage from being keyed during message recording. Therefore there will be no TX output. The sidetone, however, is still operating as the keying signal for the sidetone oscillator is taken off at a point before the short viz. directly from the keyline input.

istor.

See fig. 2 for the circuit. R12, a resistor network like R6, is located near the key connector at the right upper corner. Locate pin 2 counting from pin 1 which is marked with a square PCB island. Follow the track from pin 2 and pick a soldering island to connect the drain of the MOSFET to. Locate a suitable ground point comparing the Sierra schematic with the PCB in that area. I again stuck the MOSFET to the PCB with hot melt glue to prevent the wire to the KC-2 from pulling the MOSFET away.

That's it. I hope you find the additional functions useful. Some the above may be applicable to other rigs that have been equipped with a KC-2. If you have questions, do ask.

FYBO '98

by Joe Gervais, AB7TT
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Howdy Folks, Here it is, the results for FYBO '98! Many thanks to everyone who participated. You guys were great! Condx were tough but it seems like lots of fun was had by all. Wahoo!

Please remember that the goal of FYBO is to have fun with friends and come away with some great stories and/or lies to share around the campfire. To that end, even if you didn't have a huge score or a

logsheet full of QSOs, if you got on the air and had a good time then your FYBO mission was accomplished. Bonus points if you've already told your kids/grandkids/nieces/nephews tales of wild rabid ice weasels.

To those of you who managed to rack up logsheets full of QSOs and big scores while battling frozen fingers and iced antennas, many congrats on a great achieve-

ment! And a very special thanks to all the home ops who got on the air to join in the fun and send the Frozen Field Critters some RF to keep them warm.

Thanks again to everyone for all of your support and help. As we ScQRPions like to say, we sponsor the event, but it's all of you who actually make it happen.

So, without further ado, grab a Twinkie, Scooter Pie, or other snack of choice and enjoy the stats. Congrats to the MN QRPers at WQ0RP (wait 'til you see...) and everyone else! Cheers de AB7TT,-Joe, , AZ ScQRPions (Phoenix) "If it ain't fun, you ain't doin' it right!" — The AZ ScQRPions

FYBO '98 Trivia

— 80 Logs submitted.

— At least 80 FYBO Ops had FUN!!!

— 7 Ops operated under sub-freezing condx.

— 17 Ops were sub-40F.

— **Coldest Op:** The MN QRP Gang (WQ0RP - MultiOp) at 18F. Now that's some serious B____-freezin'!

Maybe we can keep N0TU from catching the flu next year and get him back in his snowcave for some serious competition for FYBO '99.

— 6 of Top 10 Coldest Ops were in AZ! C'mon guys, ya let a bunch of sun-baked AZ-NM QRPers out-freeze ya. The sick thing is that after living through 115F summers, we *enjoy* freezing our b____s off.

— Many congrats to our ex-N/T+ Fox N0GLM for not only being the coldest N/T+ FYBO op, but the third coldest station overall - nice job Preston! And congrats on the upgrade to Advanced! We'll figure out a special award for you! At the very least, you get your own bottle of true Southwest hot sauce.

— 3 of Top 5 scores were QRPP.

— 18 of Top 20 scores were FYBO Field Ops.

— **Highest Score:**

MultiOp - 218,448 for the MN QRP Gang (WQ0RP). WOW! Total FYBO sweep and a new FYBO record! Nearly 3 times the next highest score! Man, Coldest Temp, Most QSOs, Highest Score, WQ0RP did better than Titanic at the Academy Awards. Hats off to you folks! Better yet, keep 'em on for warmth....

SingleOp - 40,128 for Bruce (WB0CGH).

Nice one Bruce - nearly double the next closest single op score!

Most Q's

MultiOp: 123 Q's, The MN QRP Gang (WQ0RP)

SingleOp: 66 Q's, Tie between KO7X and NQ7RP

FYBO '98 PRIZES

Worked Most AZ QRP Stations: Winner - Jeff, AC6KW (16 AZ stations). Congrats! Prize - A GM-XX xcvr from Small Wonder Labs, courtesy of Jay WA5WHN and Dave NN1G. Thanks guys!

W7GVN ScQRPion Raffle: Sponsored by the AZ ScQRPions in memory of Rod, W7GVN/SK. All we ask is that you build and use these, or donate them to a "newbie" you can Elmer. Please have fun with 'em!

Winners:

38-Special Xcvr Kit: Joel, WA1QVM
Rainbow Tuner Kit: Bill, W6PRI

Lowest Field Operating Temp: Winner (MultiOp): The MN QRP Gang at WQ0RP - 14F! Yikes!

Winner (Single): Preston, N0GLM/T+ - 24F! Our Frozen Tech+. Prize: Everyone gets a bottle of authentic AZ hot sauce to help keep you warm and toasty through the next cold winter.

Lowest Home Operating Temp: Winner: Kevin, KB9IUA - 33F. Get that man a space heater! Prize: A big package of York Peppermint Patties to help give you that feeling of mushing a sled team across the frozen tundra.

FYBO '98 RESULTS (sorted by temperature)

NOTE: A (*) next to a callsign indicates multi-op.

Callsign Loc Q's SPC Temp Power Score

WQ0RP (*) F 123 37 18F 5W 218,448
AB7TT F 41 11 20F 5W 18,040
N0GLM/T+ F 9 7 24F 5W 2,240
KI0II F/H 14 12 29F 5W 4,720
NA5N/7 F 17 10 31F 5W 5,440
KI7MN F 15 10 31F 5W 4,800
N7KT F 21 7 31F 3W 4,704
K5OI/7 F 32 18 33F 5W 18,432
WA5WHN/7 F 28 7 33F 1W 6,272
KB9IUA H 20 13 33F 5W 1,040
N5ZGT/7 F 22 12 34F 4W 8,448
N0QT F 11 10 34F 5W 3,520
NF3I (*) F 69 34 37F 5W 75,072
AB5UA F 35 19 37F 2W 21,280
N4JS F 36 18 37F 5W 20,736
KO7X H 66 31 37F 5W 8,184
W4ED F 37 17 38F 5W 20,128
WB6JBM/8 F 46 22 40F 2W 24,288
N2TNN F 28 13 40F 2W 8,736
WV3B F 10 6 40F 5W 720
AF5Z (*) F 53 24 44F 4W 20,952
KI0KY (*) F 12 7 44F 5W 2,016
KN6YD F 14 6 44F 2W 1,344
WD8RIF F 29 19 46F 5W 13,224
W8MHV F 7 3 46F 5W 504
N7CEE (*) F 45 19 48F 900mW 41,040
WB0CGH F 38 22 49F 900mW 40,128
NF0R F 31 24 50F 950mW 23,808
WA1QVM H 32 22 52F 4W 2,816
AD6AY H 45 14 52F 2W 2,520
W5VBO F 25 11 53F 5W 4,400
KX7L H 40 16 54F 5W 2,560
W6RCL H 8 5 54F 5W 80
N6WG H 38 10 55F 5W 1,520
WE6W H 58 12 55F 5W 1,392
WD6FDD H 9 2 55F 5W 36
K6PZB H 12 3 56F 2W 144
AB70A F 14 7 58F 5W 1,568
N1MVU H 6 5 59F 5W 60

W5FN F 16 11 60F 950mW 5,632
AC6KW H 62 20 60F 5W 4,960
N7XJ H 56 26 60F 5W 2,916
WZ2T H 50 22 60F 5W 2,200
WB5QYT F 14 5 60F 5W 560
N8ET F 4 4 60F 950mW 256
W6KI H 16 4 60F 2W 256
VE7CQK H 8 7 60F 5W 112
AA0SM H 18 14 62F 950mW 2,016
KJ5CI F 4 4 62F 1W 128
NA3V H 17 11 63F 4W 374
N0TU/flu :-) H 11 8 63F 5W 352
WA2OCG/7 H 17 13 64F 5W 884
KU7Y H 30 14 65F 200mW 840
AA4RP H 6 5 65F 5W 30
W6PRI H 14 4 68F 5W 56
NQ7RP H 66 30 70F 5W 1,980
KL7JAF H 41 22 70F 5W 1,804
AA1IK H 44 23 70F 5W 1,012
VE3ELA H 17 14 70F 950mW 952
N5JI H 45 21 70F 5W 945
KA8OKH H 24 19 70F 4W 456
KW5OK H 20 13 70F 5W 260
AA9KH H 15 12 70F 5W 180
K3AS H 6 5 70F 5W 30
WB6FZH/KH6 H 4 2 70F 5W 8
N4ROA H 81 26 72F 5W 4,212
AB7TK H 58 25 72F 5W 1,450
N2CQ H 38 21 72F 5W 798
K0SU H 16 11 72F 5W 352
K7GT H 19 7 72F 2W 266
W3CD H 14 10 72F 5W 140
K8ZAA H 13 10 72F 5W 130
KB0SBA H 13 9 72F 5W 117
KB6FPW H 18 5 72F 4W 90
KC4MHM H 9 9 72F 5W 82
N7RI H 10 8 72F 5W 80
K8CV H 9 7 72F 5W 63
KJ3V H 8 7 72F 5W 56
K16DS H 13 3 72F 5W 52
W7HQO H 5 4 72F 5W 20

FYBO '98 RESULTS (sorted by score)

NOTE: A (*) next to a callsign indicates multi-op.

Callsign Loc Q's SPC Temp Power Score

WQ0RP (*) F 123 37 18F 5W 218,448
 NF3I (*) F 69 34 37F 5W 75,072
 N7CEE (*) F 45 19 48F 900mW 41,040
 WB0CGH F 38 22 49F 900mW 40,128
 WB6JBM/8 F 46 22 40F 2W 24,288
 NF0R F 31 24 50F 950mW 23,808
 AB5UA F 35 19 37F 2W 21,280
 AF5Z (*) F 53 24 44F 4W 20,952
 N4JS F 36 18 37F 5W 20,736
 W4ED F 37 17 38F 5W 20,128
 K5OI/7 F 32 18 33F 5W 18,432
 AB7TT F 41 11 20F 5W 18,040
 WD8RIF F 29 19 46F 5W 13,224
 N2TNN F 28 13 40F 2W 8,736
 N5ZGT F 22 12 34F 4W 8,448
 KO7X H 66 31 37F 5W 8,184
 WA5WHN/7 F 28 7 33F 1W 6,272
 W5FN F 16 11 60F 950mW 5,632
 NA5N/7 F 17 10 31F 5W 5,440
 AC6KW H 62 20 60F 5W 4,960
 KI7MN F 15 10 31F 5W 4,800
 KI0II F/H 14 12 29F 5W 4,720
 N7KT F 21 7 31F 3W 4,704
 W5VBO F 25 11 53F 5W 4,400
 N4ROA H 81 26 72F 5W 4,212
 N0QT F 11 10 34F 5W 3,520
 N7XJ H 56 26 60F 5W 2,916
 WA1QVM H 32 22 52F 4W 2,816
 KX7L H 40 16 54F 5W 2,560
 AD6AY H 45 14 52F 2W 2,520
 N0GLM/T+ F 9 7 24F 5W 2,240
 WZ2T H 50 22 60F 5W 2,200
 AA0SM H 18 14 62F 950mW 2,016
 KI0KY (*) F 12 7 44F 5W 2,016
 NQ7RP H 66 30 70F 5W 1,980
 KL7JAF H 41 22 70F 5W 1,804
 AB70A F 14 7 58F 5W 1,568
 N6WG H 38 10 55F 5W 1,520
 AB7TK H 58 25 72F 5W 1,450
 WE6W H 58 12 55F 5W 1,392
 KN6YD F 14 6 44F 2W 1,344
 KB9IUA H 20 13 33F 5W 1,040
 AA1IK H 44 23 70F 5W 1,012
 VE3ELA H 17 14 70F 950mW 952
 N5JI H 45 21 70F 5W 945
 WA2OCG/7 H 17 13 64F 5W 884

KU7Y H 30 14 65F 200mW 840
 N2CQ H 38 21 72F 5W 798
 WV3B F 10 6 40F 5W 720
 WB5QYT F 14 5 60F 5W 560
 W8MHV F 7 3 46F 5W 504
 KA8OKH H 24 19 70F 4W 456
 NA3V H 17 11 63F 4W 374
 N0TU/flu H 11 8 63F 5W 352
 K0SU H 16 11 72F 5W 352
 K7GT H 19 7 72F 2W 266
 KW5OK H 20 13 70F 5W 260
 N8ET F 4 4 60F 950mW 256
 W6KI H 16 4 60F 2W 256
 AA9KH H 15 12 70F 5W 180
 K6PZB H 12 3 56F 2W 144
 W3CD H 14 10 72F 5W 140
 K8ZAA H 13 10 72F 5W 130
 KJ5CI F 4 4 62F 1W 128
 KB0SBA H 13 9 72F 5W 117
 VE7CQK H 8 7 60F 5W 112
 KB6FPW H 18 5 72F 4W 90
 KC4MHM H 9 9 72F 5W 82
 W6RCL H 8 5 54F 5W 80
 N7RI H 10 8 72F 5W 80
 K8CV H 9 7 72F 5W 63
 N1MVU H 6 5 59F 5W 60
 KJ3V H 8 7 72F 5W 56
 W6PRI H 14 4 68F 5W 56
 KI6DS H 13 3 72F 5W 52
 WD6FDD H 9 2 55F 5W 36
 K3AS H 6 5 70F 5W 30
 AA4RP H 6 5 65F 5W 30
 W7HQO H 5 4 72F 5W 20
 WB6FZH/KH6 H 4 2 70F 5W 8

FYBO '98 Soapbox: Fun Fun Fun!! I had a horse, a donkey and three ducks for company. N5LU came by to check on me. He felt sorry for me and took me to town for lunch ... a fantastic contest! It warmed up to 50F with SUN! — Clif, AB5UA

This was my first CW contest. Chris (W0ITG) and I had a blast ... We were assisted by a 12-year-old who is still interested in ham radio. Train them

young and they'll be QRPers forever! — Steve, K1OKY

REALLY enjoyed FYBO. My first ever CW contest! And particularly glad to work you at 2135. — Joe, KW5OK

N6CNY and I had planned on heading up into the Mendocino Nat'l Forest again, but bad wx put a stop to that. I got more than three inches of rain over the weekend. We'll try again next year with a camping trip. — Mitchell, KB6FPW

Perfect day for FYBO, mild but cold enough for x6 multi. Thanks for fun contest. — Jim, N0UR (WQ0RP multi-op)

This was my first FYBO and it won't be my last! — Brian, N5ZGT

20m never opened when I was operating. — Greg, WB6FZH/KH (Manager's Note: Hey Greg, who needs the bands open when you live in paradise!)

The practice time I did on sending while wearing mittens sure paid off. The kids thought I was crazy, outside doing the hula and singing "We're Havin' A Heat Wave".... Probably coulda done better if I'd quit running inside to warm up and drink coffee ... Thanks for another round of fun! — Jan (N0QT)

Fun contest! — Bill, K3AS

I missed the first 5 hours during the middle of the contest and then was overwhelmed by the NA Sprint, but had great fun. — Glenn, W6KI

Was looking forward to operating in the field. Had a nice site picked out, but came down with a flu bug ... just played at it for a few hours when I felt up to it ... Thanks for a great contest! — Ken, VE5ELA

My first FYBO Winter QRP FD. Lots of fun. — Bill, W6PRI

20 ft vertical good for coast to coast, not so good for states close in. A lot of fun up to the last hour, that's when the cold got to me. Twice the points of last year - more fun. — Bob, W4ED

Fun contest! Tried the kite antenna for a bit - no wind! Used OHR Spirit and 180 ft counter-fed Zeppup 25 ft. Next year hope to do better! — Tom, WB5QYT

It was fun and a good excuse to get a new antenna up. — Bill, KJ5CI

Great contest! We had fine wx and a pleasant location next to Beaver Creek. — Bruce, N7CEE and Scott, K7ZEN

Great fun! Wish I could have operated more than a few hours. Working AH7R made me smile. How do you freeze anything off in Hawaii? — Charlie, KX7L (Manager's Note: Lots of frozen pina colodas!)

Lots of fun trying to build, operate and align at the same time! — "Kim" Kimura, N1MVU

I had a blast. I can't wait until next year. — Preston, N0GLM

About 3 hours of QRP fun. No time to set up with multipliers but glad to QSO as many as possible. 7 QSOs with AZ, and KL7JAF as best DX. CU next FYBO! — Ken, N2CQ

Great contest, with fairly good turn-out of eastern stations. Next year, if I can get an antenna for the high freqs I may go after a big score. HI. — Jim, NA3V

What fun! Not quite as cold as we would like, but for most of us "cliff dwellers" it was a chance to use "real" antennas. Three ops and about ten very interested visitors. Lots of Tech/Tech+s to break in for the next one! Lots of fun to know the names before they were sent. A keeper! — Chris, N3XRV (with Scott NF3I and George K3TKS)

Not a stellar performance, but a lot of fun. I always look forward to these events. Maybe next year I'll try for the temperature multi. Thanks to you and everyone who puts this on. — Rick, K0SU

Only able to operate a couple of hours, but enjoyed it very much! — Drew, W8MHV

On and off operation from horrible most unbearable temp of 72F - Had lots of fun. — Dan, N4ROA

About the same time I finished my chores and could sit down and work the contest, the NA Sprint came along and I could hear nothing else. Look forward to next time. — Ronnie, KI0II

Great day and great fun! — Bruce, WB0CGH

When I arrived [at my site], I discovered that I was at the snow line and then the wind started to blow and then the clouds came rushing in, so I strung up my 185 ft longwire and fired up the HW-7 ... the dog was shivering and I couldn't feel my fingers ... Thanks so much for the 2nd FYBO. I hope you had as much fun as I did. — Jeff, KN6YD (Manager's Note: That's the FYBO spirit, Jeff!)

I alternated between hunting for DE, the last state I need for QRP WAS, and FYBO. I got 3 DE stations. Had what I considered a nice run of 11 FYBO stations in an hour on 15 m. Also got some NH and VT QSO Party stations. — Randy, AB7TK

I had fun. The best part, was the eyeball QSOs with the Az. Crew and working everyone on the air. Yahoo !! Will be back next year. — Jay, WA5WHN/7

My company picked one heck of a time to need me in the Netherlands, and I missed the event this year.... maybe in '99.... — Jack, WA8GHZ/5

Antenna certainly wasn't sleet/wind proof :-(Had to piggy-back on NQ7K W5VBO's operation ... good fun and comederie, tho. :-) — Kent, AB7OA

Here is my FYBO entry. Thanks for your fine effort and hope you have the energy to do it again. I had a great time right up to the point when my brain turned into a ghost f**t. — Ed, KC4MHM

While I was in the backyard operating, we had just a little rain but a lot of wind and about an eight/nine inch (dia.) limb fell from the tree, missed the house though. Grand kids in and out all day, you know birthday stuff, so it was a very hit and miss operation, mostly miss, but had a good time. — Rich, WD6FDD

It sure was a VERY fun contest and I look forward to it becoming a regular one. I do plan to operate the next one out in the field. I have 2 friends who like QRP work and I am going to try to encourage them to come with me and make a little group effort. — Lynn, KJ3V

Had fun although I didn't operate a lot nor outside my house. But it was the first time I have really tried to run at milliwatt levels in a contest. Also, there seemed to be a lot of noise here and I had to work hard to copy some of the QSOs. That made it a good learning experience. — Tony, AA0SM

Mighty big score.....NOT! — Walt, K8CV (Manager's Note: Heck, as long as ya had fun, you won! Thanks for coming out!)

Thanks to all the AZ ScQRPions for making this event happen... Thanks to all the participants that made it a fun event... Good conditions here in Alaska... Next year we will see if we can work on the temperature multiplier... 72 — Bruce, KL7JAF

Mucho fun! Too damn cold! Can't wait 'till next year. Or at least until BUBBA! — Bob, KI7MN

Ice storm took care of the antenna's. The 80m dipole is in the snowbank and the 40m delta loop is resonant on 6m. — Rich, WZ2T (Manager's Note - We've gotta make a multi for snow-bound antennas!)

I consider this my first *real* contest ... Most notable contact was Zack, W1VT. Heck, he's a celebrity in my mind! The

most impressive contact: Scott, N7CEE, showed me what you can do with less than a watt on 40m! And he was loud! ... I'm looking forward to the next FYBO! — Bob, W3CD

Had a grand time! The weather was beautiful, blue skies & 60s. Mebbe next time I'll take less stuff.. glad I didn't have to hike in to the site! — Tim, W5FN

Had Fun!! — Bill, N8ET

I was warm as toast! While staying close to the 'john' (nursing the intestinal flu) and feeding my wood stove I managed to nabbed a few of the lucky ducks who were out there really FYBOing. Next Year... to the Field! And NO FLU! — Steve, N0TU

What a blast! A steady 31 deg with snow falling all day, light wind, and COLD! Gaps in the log are not from poor condx....just got too cold and had to warm up a bit. — Roger, N7KT

My plans for a solo FYBO winter outing fell through at the last minute. ... I opened the outside door to the shack to cool things off a bit ... it was 34 F outside, but it only got down to 60 F in the shack before the family started screaming at me. Next year it's snow caves for sure ... but I need a crazy partner. — Bob, N7XJ (Manager's Note: Plenty of us crazy ones out there, Bob. We'll take care of ya next year!)

Thanks for all the contacts and did manage a new state, NH. Dissapointing that the skip was so short but it was nice to hear the locals. Lets get set for next year and maybe a new mult for the temp. I couldn't get it to go down 1 degree to 39F. maybe with the windchill but no banana!! — Dean, N2TNN (Manager's Note: How about a banana multi?)

I just stumbled into this contest and had real fun! Thanks for it and I'd like to

have more connections with you guys. — John, K6PZB

The surprise contact was by far Ade, W0RSP, one of my heroes — glad we finally meet on the air! Got plenty of strange looks from my neighbors and others walking/driving by, but I had a blast ... Thanks for sponsoring the contest! — Kevin, KB9IUA

Lots of fun and thanks to all the ScQRPions who organized it, thanks to the Pinetop gang for drumming up the publicity and thanks to the participants for some great fun! Wait til next year!! — Doug, KI6DS

Didn't spend much time in the contest but did have fun! Anyone who doesn't play around in the FYBO must not be crazy.... — Ron, KU7Y

Couldn't get the *@^%! temp to drop below 20F - ARGH! Next year I'm bringing the liquid helium. — Joe, AB7TT

It was 37 deg as I set up a little after 1600Z. After an hour, it started to sleet. Only place in NJ with weather that lousy! Little FYBO activity heard on 20, although DX was good. 40M was "bread and butter" band. Operated most of time from inside Explorer, but had to have window open both for temperature multiplier, and because I was smoking noxious cigars! — John, N4JS

My operation was a bit disjointed, as it felt like I was set up by a stream. We had so much water in the back yard it came in through the back of the garage. I spent a lot of time with a squeegee escorting it out the front into the driveway. Talk about high humidity. — Bob, N6WG

I did not work the whole period, but I did have a blast working all the people we see on the net. — Joel, WA1QVM

A truly great contest. Was planning a field location but the non-stop rain and severe floods in our county made this impossible. — Ed, WE6W

QRP HINTS & KINKS

A NorCal Exclusive

Illustrated by Paul Harden, NA5N

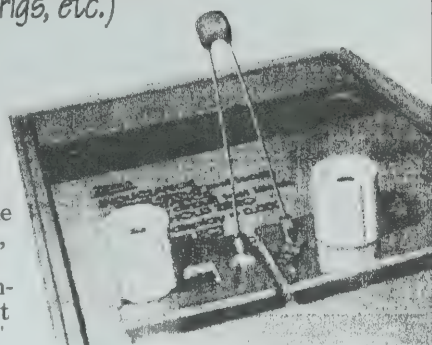
#8

More Build-It-From-Scratch Stuff (Pixies, 2N2222 rigs, etc.)

An L-C Meter Test Jig

From Chuck Adams, K5FO
Dallas, Texas

L-C Meters usually come with fairly large binding posts, making it tough to measure small components. Make two small "shelves" from copper clad, soldering on wire wrap socket pins (or similar), for measuring small components as shown. Shelves are about $\frac{3}{4}$ "x1" pieces of copper clad with a $\frac{1}{4}$ "



AADE L-C Meter sl mn
(Almost All Digital Electronics)

Capacitor Value Markings

109*	1pF	102	.001uF
100	10pF	103	.01uF
101	100pF	104	.1uF
102	1000pF	105	1uF

*Used by some manufacturers
to denote less than 10pF

slit cutout with a nibbling tool. The slit slips into the binding post and allows it to be adjusted for the proper "gap" between the two terminals. A close gap can be used for testing small or surface mount components.

PIXIE Tunable Output Filter

From Arnie Coro, CO2KK
Havana, Cuba

The Cuban's have built the Pixie-2 and achieve better receiver sensitivity by using variable caps in the output filter. Peak for maximum output power, then peak for maximum signal strength on receive. Note that L1 is 8T of #22 solid insulated wire on a PVC form for the required 1uF instead of a toroid form.

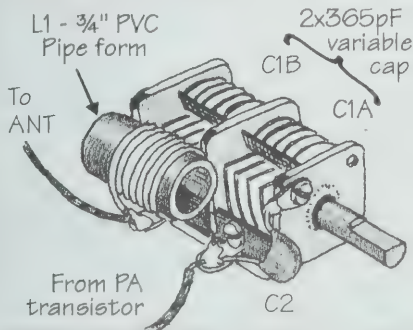


PIXIE values:

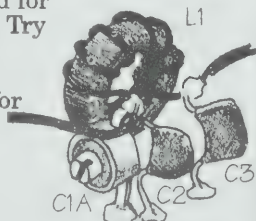
80M L1=2.2uH C1A+C2=820pF

40M L1=1.0uH C1B+C3=820pF

Pixie-2 designed by Dave Joseph,
WA6BOY. See June 1995 QRPp, p. 45-48



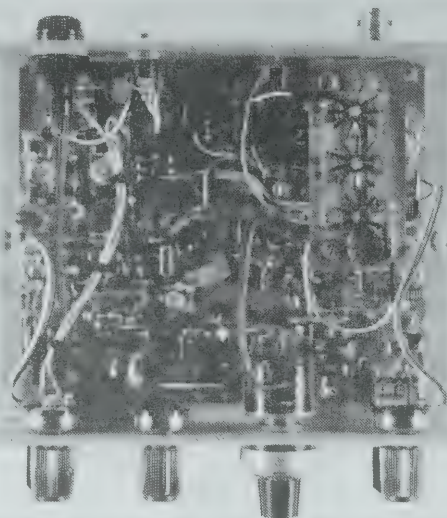
For those who think QRP means small, trim cap(s) can be used with a toroid for same effect. Try this on any QRPp rig to peak filter for maximum receiver sensitivity.



Next Issue: more on homebrew coils

Some "Ugly Construction" Practices (The K8IQY 2N2222 QRP Rig)

One "ugly construction" method is to use small copper "pads," or "islands," glued to the working surface (usually a solid piece of copper clad) for affixing the components and wiring. This construction technique was excellently executed by Jim Kortge, K8IQY, on his award winning 2N2222 rig (1st place at the NorCal building contest, Dayton, 1998), for which a few examples are detailed here.



Front panel controls:

- RF Gain
- Audio Gain with ON/OFF switch
- RF Pre-amplifier (10dB or 20dB)
- 10-turn TUNE with vernier
- XTAL Filter bandwidth, adjustable 250-750 Hz.
- Phones

Rear panel controls:

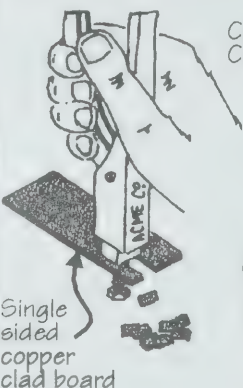
- Antenna BNC
- Fuse holder
- DC input jack
- KEY jack

The Copper Clad "Pad" Technique

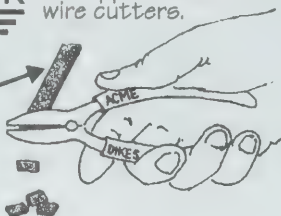
- 1** Cut-out small pieces of copper clad with a nibbling tool.



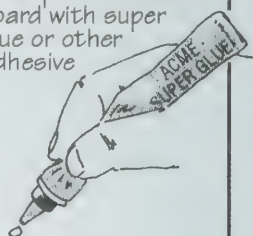
Cut pieces from strips of copper clad with wire cutters.



Copper Clad

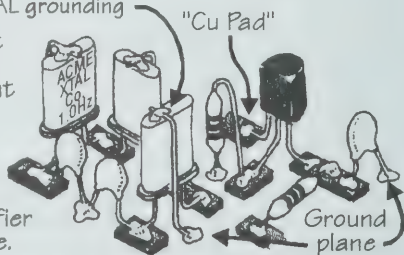


- 2** Affix copper pads to main board with super glue or other adhesive



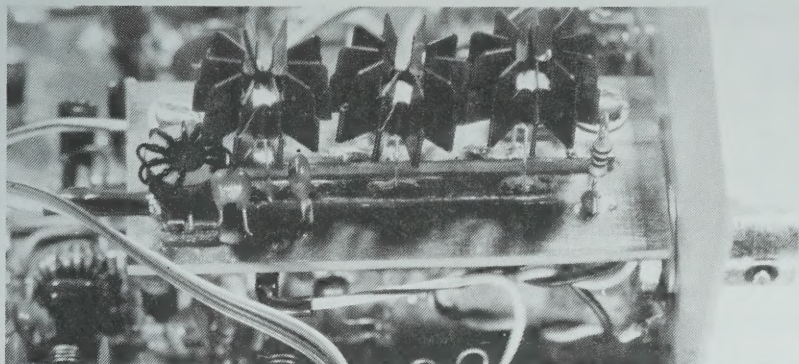
Note XTAL grounding

- 3** Layout circuit on paper for proper arrangement then solder the components in place.
K8IQY's crystal IF filter and an amplifier are illustrated here.

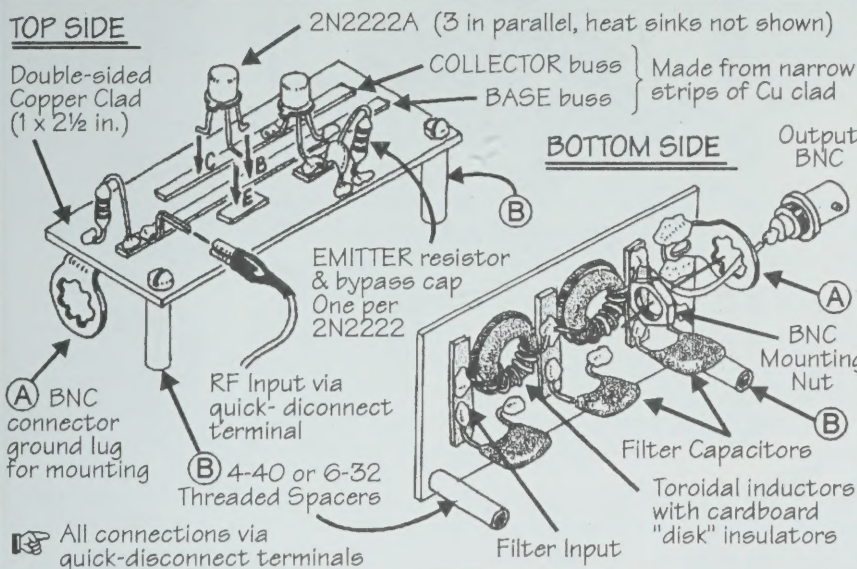


Stand-alone P.A. Assembly

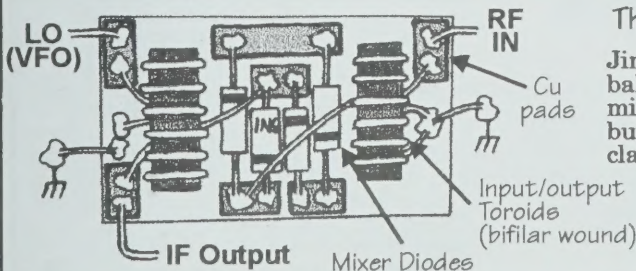
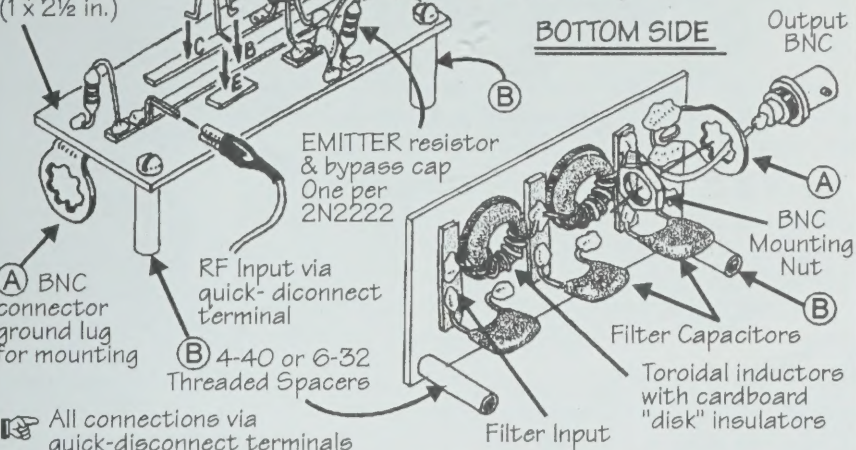
K8IQY used a clever method of building a 2.5W (three 2N2222A's in parallel) on a separate piece of copper (Cu) clad. This would allow building other P.A.'s, such as with power MOSFET's, to be easily installed in this rig by simply "swapping" P.A. boards.



TOP SIDE



BOTTOM SIDE



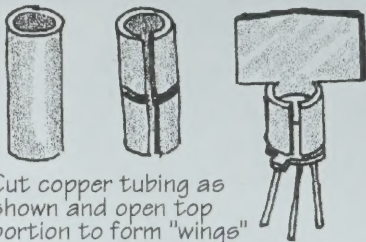
The Receive Mixer

Jim used a double-balanced diode ring mixer with 1N914's, built on a 1/2"x3/4" Cu clad platform. Note efficient placement of parts. MDS is better than -112dBm!

HEAT SINKS GALORE (for TO-18 and TO-39)

Heat sinks for the metal can transistors are less than \$1 each, but here's a few techniques for rolling your own. The idea of a heat sink is to transfer heat from the device to the air or other absorber quickly. Also note the metal can is often connected to the emitter or collector!

USING COPPER TUBING

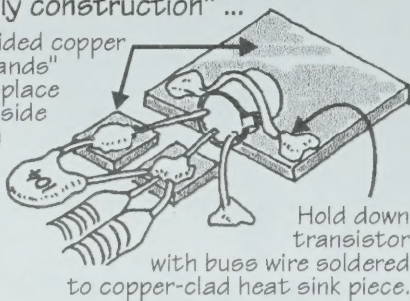


Cut copper tubing as shown and open top portion to form "wings"

Use 1/4" dia. for TO-18 • 3/8" dia. for TO-39

For "ugly construction" ...

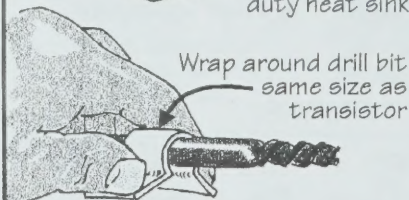
Single-sided copper clad "islands" glued in-place (Copper side on top)



Hold down transistor with buss wire soldered to copper-clad heat sink piece.

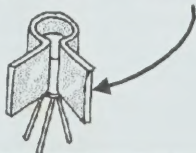
The OLD CLASSIC

Form piece of metal or aluminum as shown. Cut from metal food can for light duty heat sink.



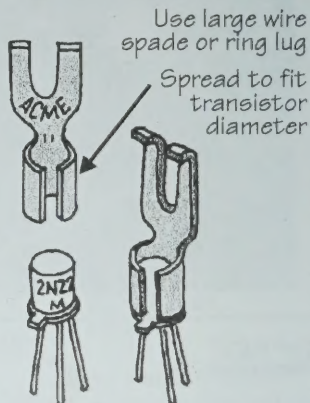
Wrap around drill bit same size as transistor

"Wings" can be squeezed or spread apart for tight fit on the device.



The SPADE LUG SPECIAL

From D.K. Philbin, KD6TK

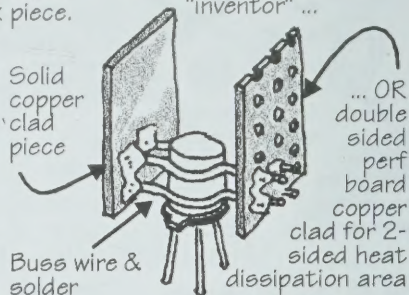


Use large wire spade or ring lug

Spread to fit transistor diameter

The EMPIRE STAR FIGHTER

I saw this at a building contest, but forgot the "inventor" ...



Solid copper clad piece

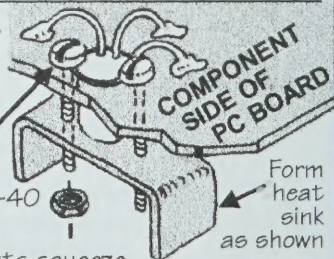
Buss wire & solder

... OR double sided perf board copper clad for 2-sided heat dissipation area

Transistor mounted thru hole "upside-down"

2-56 or 4-40

Bolts & nuts squeeze heat sink & transistor together. Saw this on a submarine sonar board!



COMPONENT SIDE OF PC BOARD

Form heat sink as shown

NorCal K8FF Paddle Kits

The NorCal Paddle Kit will consist of all the parts needed to build the kit, including the base, machined brass parts, and all hardware. The kit is unfinished. The machining has been done for you, but it is up to you to finish the kit by polishing the brass parts and painting or plating the base. The cost of the kit is \$30 plus \$5 shipping and handling in the US, \$10 shipping and handling for Western Europe and Canada, and \$15 shipping and handling for the Pacific Rim. To order send your check or money order (US Funds Only) to: Jim Cates, 3241 Eastwood Rd., Sacramento, CA 95821, USA. Make checks and money orders out to Jim Cates, NOT NorCal.

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Please send orders to: Doug Hendricks, 862 Frank Ave., Dos Palos, CA 93620, USA

QRP Frequency Crystals

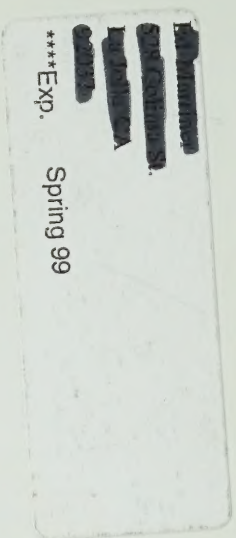
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<i>Paul Hardin, NASN</i>	<i>Sandra</i>

NorCal members were recently called "Zombies" on QRP-L. Be proud to be a NorCal Zombie! Cutout Zombie badge for hamfest ID, or contact NASN@Rt66.com for laminated version.



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